



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>



Sci 1490.50

**Harvard College
Library**



By Exchange

THE
MECHANICS' MAGAZINE.

AND

JOURNAL OF ENGINEERING, AGRICULTURAL MACHINERY,
MANUFACTURES, AND SHIPBUILDING.

VOL. XIV.

(NEW SERIES).

JULY TO DECEMBER, 1865.

83

LONDON:

**ROBERTSON, BROOMAN, & CO., "MECHANICS' MAGAZINE" AND PATENT OFFICES,
166, FLEET STREET, E.C.**

80141050

✓

HARVARD COLLEGE LIBRARY
BY EXCHANGE

1939

698
42-185
19-3

INDEX.

- ABEL, F. S., compound of copper and phosphorus, 163
 Acid, cheaper production of pyrogallol, 246; new method of obtaining chloroxynaphthalic, 129
 Addenbrooke G., waste gas from open-topped blast furnaces, 297
 Agrolites, fall of two, 313
 Agrostation, history of, 47, 63; scientific, 32
 "Affordators," the, 332
 Ager's fan blowers, 331
 Agricultural chemistry, discoveries in, by Dr. F. C. Calvert, 248, 267, 282, 299, 378, 396; machinery of the United States, 395; railways, 313
 "Algonquin" and "Winoski," the, 364
 Alkali waste, utilisation of, 368
 "Allemania," 152
 Alloys of cadmium, extreme fusibility of, 220
 Aluminate as materials for crucibles, 210; of lime, properties of, 210
 Aluminium bronze, the nature of, 277
 American emery, 98; ironclad trials, 159; locomotive, heavy, 200; marine engine trials, 263
 Ames gun, the, 1
 Ammonium amalgam, theory of the constitution of, 293; supposed compound metal, 293
 Ames and Anderson's tubular boilers, 361
 Anderson, Professor, chemistry of wool, 85
 Anhydrous liquids, the solvent properties of, 359
 Animal charcoal, revivifying, 245
 Animals, congelation of, 390
 Annals, 404
 Ansell's fire-damp indicator, 267
 Anthracite coalfields of Pennsylvania, 323
 Appold, the late Mr., 152
 Armour plates, testing of, 391; plating, 339
 Armstrong Sir W. G., chain testing machines, 164
 Artificial avarantine, new kind of, 277; cold for the extraction of sugar, application of, 146; light for photography, 348
 Astronomy, 147
 Atlantic telegraph, 31, 47, 95, 111, 112, 115, 130, 143, 403; deep sea soundings, 184
 Atmospheric insulation, 345
 Atoms, size and weight of, the, 326
 Axton's brick-making machinery, 261
 Ayton's improved plan of drawing coals, 69
 BAILEY, S., South Staffordshire coalfields, 179
 Ball and jet, the, 381
 Barmouth viaduct, 144
 Barometer, new, 247; variations of during the gales, 392
 Barometric registration, new method of, 328
 Barrett, W. F., contact of hydrogen flame, 347
 Batteries for generating electricity, 19
 Baugh's boot-making machinery, 133
 Baylis's punching machines, 199
 Beaumont's gas furnace, 167
 Beckton's blast furnace, and the manufacture of pig iron, 22
 Becquerel's thermo-electric battery, 98
 Bell, A. H., telemeters, or instruments for measuring distances, 279, 296
 "Bellerophon," the, 184, 300
 Bennett, H., puddling iron by machinery, 165
 Benzoin acid from naphthalene, 129
 Benson's casting steel, 198
 Bessemer, Mr., manufacture of cast steel, 168
 Bertsch's electric telegraph protectors, 100
 Blackfriars Bridge, 159
 Blasting agent, another new, 278
 Boats, propelling, 285
 Boiled iron, 243
 Boiler Association, Manchester, 9, 131, 281, 391; explosions, steam, 307; feed-water apparatus, 346; incrustation, steam, 101; the "Field," 18, 70; work, punched v. drilled holes, 15
 Boilers, attachment to steam, 20
 Books, notices of, 17, 128, 177, 228, 324
 Bolts for shipbuilding, 70
 Boulton and Watt, 341, 356
 Bramwell, F. J., weldless tyres, circular rolling and railway wheels, 213
 Breakwater in Mount's Bay, 267
 Brearey, F. W., on aerial navigation, 178
 Breton's reaping machine, 9
 Brewster, Sir D., on patent rights, 361
 Bridge, Blackfriars, 159; over the Niemans at Korvno, 214; Scheldt, Anderdon, 6; Schuykill, Philadelphia, 281
 Bright, C. T., on the telegraph to India, 315
 British Association, the, 147, 162, 178, 195; mineral rich in serum, a, 359
 Bromine and bromides, 380
 Buffer springs, 119
 Bursens, Sir J., railways in war, 181
 CALIFORNIAN diamonds, 82
 Calorimeter safety valve, 328
 Calvert, Professor, action of acids on metals and alloys, 163; discoveries in chemistry, 248, 267, 282, 299, 378, 396
 Candles, manufacture of, 116
 Canham's blast furnaces, 344
 Cannon, new, 83
 Carbon and silicon, classification of, 66; compound sensitive to light, 376
 Carbonic acid, production of pure, 129
 Carhart's oscillating steam valve, 132
 Casket portraits, 267
 Cause of soda from sulphate of sodium, 309
 Cement, a new hydraulic, 376
 Charcoal, revivifying animal, 245
 Channel, date of the English, by J. Prestwick, 10
 Chemistry, 148; applied to arts and manufactures, by Dr. F. C. Calvert, 248, 267; discoveries in agricultural, by Dr. F. C. Calvert, 378
 Chimney tops and ventilators, 21
 Chloroxynaphthalene as pigments, the, 129
 Chirmer's Hydrants, 68
 Circle, motion in a, by E. Sang, 10, 24
 Cigar ship, 162
 Clarke, J., problem of the pyroscope, 365
 Claxton's improvements in railway carriages, 105
 Club Snow, the Smithfield, 371, 386
 Clyde shipbuilding, 152; steam dredgers, on the construction and working of, by A. Duncan, 37, 51
 Clydonics, Professor, S. D. Tillman, 40
 Coalfields of South Staffordshire, by Professor Jukes, 230
 Coconut shell charcoal, absorbent power of, 359
 Coalfields of Pennsylvania, the anthracite, 323
 Cologne Exhibition, steam fire engines at, 4
 Colomb's flashing signals, 84
 Combe, J., variable speed, 378
 Combination ratchet brace, 365
 Combustion of fuel, facilitating the, 408
 Compasses and adjusting magnets, 88
 Condensers, injection, 113; surface, 127
 Connecting rods, 375
 Cormack's distilling hydrocarbons, 162
 CORRESPONDENCE:—
 Action of acid on metals, T. L. Phipson, 316
 Anchor trials, W. Roberts, 382
 Atlantic cable, O., 137; J. Hope, 13; and its failure, Benjamin Chaverton, 120; telegraph, W. Wright, 41; C. P. Aston, 41; cable, F. Denby, 89, 121
 Breach-loading ordnance, 11
 British rainfall, G. J. Symonds, 350
 Cast-iron guns, J. Norton, 382; rifled cannon, J. Norton, 316
 Cattle plague, the, J. Bruce, 321
 Cellular bridges, G. W. Phipps, 56; Writer of the Article, 72
 Cigar vessel, the, J. Kennedy, 163; R. Aytoun, 169
 Combustion of coal in furnaces, Enquirer, 334
 Compound guns, W. Palliser, 301, 318
 Compressed moist hot-air engine for marine purposes, T. Parker, 333
 Conduction and inductive retardation, S. Taylor, 397
 Daniell's battery, J. F. E., 72
 Flying machines, M. S., 41
 French gun of the future, W. Palliser, 253; P. M. Parsons, 333
 Iron and granite forte, Ironsides, 382
 Light draught roller ship, T. Moy, 316, 366; W. Barber, 302, 349
 London Association of Foremen Engineers, J. Newton, 56
 Mechanical flying machines, J. Parker, 72
 Negative ship, Hall, 221; J. Elwin, 253; T. Moy, 201
 Peat fuel, A. C., 185
 Problem of the torpedo, A. Naval Officer, 269
 Rain gauge, A., 169; E. H. Clark, 237; J. F. E., 263
 Recent improvements in the steam engine, An Old Subscriber, 41
 Revivifying animal charcoal, O. Gerken, 185
 Safety gunpowder, C., 121; Lucifer matches, Inquisitor, 316; Bryant and May, 333; Paterfamilias, 333
 Softening clay, P. Hart, 332
 Steel rails, J. Todd, 26
 Sugar refining, O. Gerken, 221
 Symonds v. Foxwell, T. E. Symonds, 89
 The gun question, A. B. T., 253
 Times on the patent law, T. Moy, 185
 Torpedoes, W. Smith, 237
 Tubular boilers, C. F. T. Young, 398
 Use of paraffin, J. Macintosh, 316
 Watering cattle waggon, A. J., 221; W. E., 237
 Wave-line theory, F. Denby, 121
 Correspondents, 11, 26, 41, 56, 72, 89, 105, 121, 137, 154, 169, 185, 201, 221, 238, 253, 269, 285, 302, 318, 334, 359, 366, 411
 Cotton spinning, 207
 Cotton hair, dissolution of, by J. B. Danvers, 25; press compound, 200
 Cowper, E. A., a new cotton gin, 181; blowing blast furnaces, 166
 DAGLISH, Mr., on a new water gauge, 69
 Deans, M. P., on the emission of luminous radiation of a red heat, 71
 Despatch, pneumatic, 291
 Detection of very small quantities of the halogens by spectrum analysis, 343
 Devereux's self-acting syphons, 183
 Diamond, expansion of the, by H. M. Pizcan, 73
 Dickinson, J., on the Lancashire coalfields, 53
 Disinfection, processes of, 82
 Doubleday, Mr., on the causes of certain boiler explosions, 236
 Drury's lubricating cylinders, 214
 Dublin waterworks, 83
 Duncan, A., on the construction and working of the Clyde steam dredgers, 37, 51
 ELECTRICAL relations of aluminium, 277
 Electric waves in submarine telegraph lines, retardation of, 358
 Electricity as a means of taking soundings in deep water, 312
 Electro-magnet locomotive, 98, 232; motive force of voltaic couples, influence of heat upon, 376
 Elements, natural grouping of, the, 66
 Embleton, Mr., on a coal-cutting machine, 69
 Enfield rifles, converted, 143
 Engine, double cylinder revolving, 72; heated air, 347; improved steam, 252; trial, competitive, 115; trials, American marine, 262
 Engineering energy in America, 327
 Engineering papers, 1
 Engineers, Institute of Civil, 9, 315, 361, 393; Mechanical, 297; Northern Institution of Mining, 35, 53, 69, 236; society of, 409
 Engines, adhesion of locomotive, by V. Pendred, 294, 311; friction of, 180, 175; paddlewheel, 64; screw, 80, 409; steamfire, at the Cologne Exhibition, 4
 English iron ores and their products, 192
 Essex steel works, the, 182
 Essex coast, reclamation of, 19
 Ethnology, 148
 Exhibition, the first industrial, 19
 Exhibition of 1867, the French, 100, 261
 Experiments in glass-making, 323
 Explosions, gas, 275
 Explosive substance, a new, 89
 FAIRBAIRN, Dr., on gun cotton, 181; Atlantic telegraph cable, 164; construction of iron ships, 165
 Ferrosum and ferricum, value of, 263, 277
 "Field" boiler, the, 15, 70
 Finch, Dr., on the utilisation of blast furnace slags, 164
 Fire and burglar alarm, 219
 Fireproof flooring, Phillips's, 291
 Fleitman's process for obtaining oxygen, 375
 Flux for use in copper smelting, 88
 Flying machine, 20
 Forbes, Dr., minerals from South America, 179
 Formic acid, industrial preparation of, 263
 Foundations, undersunk, 120
 France, puddling machinery in, by M. Gaudry, 278
 French engineering manufactures, 328; gun of the future, 227
 Friction of engines, 175
 Funnel and measure, combined, 69
 Furnaces, 409; reverberatory, 49; Siemens's regenerative gas, 355
 GALLOWAY, G. B., intercommunication between railway passengers, 180
 Gas explosions, 275; furnaces, Beaumont's, 16
 Gases contained in molten iron and steel, 375; diffusion of, 34
 Gaudry, M., puddling machinery in France, 278
 Gauges, rain, 144
 Geography and hydrography, 149
 Geologic origin of the South Staffordshire iron ores, 359
 Geology, 148
 Gerstenhoffer's furnace for smelting copper ores, 210
 Giffard's injector, by L. Olrick, 395, 409
 Gilroy, Mr., on a coal-washing machine, 69
 Ginning cotton, 207
 Glaisher, Mr., mapping the moon, 163
 Glaisher's report of the balloon committee, 195; night balloon ascent, 236; variations of the barometer, 292
 Glass, colouration of, by selenium, 277; making, experiments in, 323
 Glycerine for moistening modelling clay, use of, 311
 Gold coins, falsification of by means of iodine, 263; in the interior of the earth, 146; the colour of, 179
 Goodman, J. D., the gun trade, 180
 Granite and iron fortifications, 349
 Graphitic acid, formation and constitution of, 376
 Graphotype, 373
 Graving dock at Jarrow, new, 197
 Gravitation and its relation to universal force, by H. F. Walling, 284
 Greenway's railway turntables, 131
 Greenwell, on sail ropes, 69
 G imshaw, Mr. W. D., high speed compressed air hammer, 329
 Guncoyl stone as fuel, use of, 194
 Gun and shell, the Holland, 66
 Gun competition, rifled, 191, 208; motion of advance of a shot down the bore of a, 243; the Ames, 1; Ericsson, 37; French of the future, 227; Scott v. the French, 175; trials, 267
 Gun cotton as a motor of machinery, 82; manufacture, progress of, by Mr. Prentice, 219, 231; new researches respecting, 263
 Gunpowder on board the "Scorpion," 131
 Gunpowder, compressing, for blasting, 264; non-explosive, 37, 247; protected, 240; safety, 63
 Guns, compound, 216; the force giving rotation in rifled, 208; working heavy, 83
 Guit, Dr. A., naval and hydrographical telemetry, 359
 HALL'S agricultural machinery, 265
 Hart's postage stamp and gum label affixer, 381
 Hawkins's diving mask, 4
 Harrison, J., cleaning iron ships afloat, 135, 153
 Hicks's steam engine, 65
 Hodgson and Pitts' combined drill vice and lift, 315
 Hollow iron ship construction, 404
 Holmes, N. J., district private telegraphs, 197
 Hooper, W., on India-rubber, 162
 Hoosac Tunnel, the, 275
 Hughes' armoured-plated ships, 70
 Hydrogen, colouration of, harming, by atmospheric air, 310; flame, contact of, by W. F. Barrett, 347; remarkable effects of, 295
 ILLUMINATOR for opaque microscopic objects, H. L. Smith's, 252
 Iminium, existence of the metal, 210
 Indian telegraph, the, 127
 Induction spark, heat of the discharge upon the path of the, 18
 Injection condensers, 118
 Internal heat of the earth, 263
 International communication, 359
 Iodine and bromine, relative abundance of, 343; probable existence of, in Cornish ores, 263
 Iron, boiled, 243; casting malleable, 3; exceedingly hard, 389; first project, the, 8; for carbon and silicon, affinity of, 310; from phosphorus and sulphur, 146; influence of the heat on the allotropic condition of, 328; Lake Superior, 270; ores and their products, English, 192; produce of France, 281; properties of manufactured, 263; rails, treatment of, 356; shipbuilding, progress of, 308; ships afloat, cleaning, by J. Harrison, 135, 153; the quantity of, in blood, 82; unprecedentedly pure, 66
 Ironclad trials, American, 159
 Is nitrogen an element? 246
 Ivory, artificial, 263
 JACKSON and Gisholm's beer pumps, 251
 Johnson, H., duration of the South Staffordshire coalfield, 196
 Johnson, W., parallel jaw vice, 379
 Jowett's rail and railbearers, 167
 Jukes, Professor, coalfields of South Staffordshire, 230
 KNAB'S improved motive power, 68
 Knowles, Mr., J., pumping and winding engines, 53
 LAKE Superior iron, 220
 Launch of the "Lady Derby," 231
 Lavoisier, 80
 Laws governing the attractive force of electro-magnets, 98 the patent, 98
 Lea, M. O., invisible photographic images, 105
 Lead, erosion of, 117; poisoning, 117
 Leather, artificial, 35
 Leeds Association of Foremen, 37
 Lenoir gas engine, modification of the, 311
 Levick, T., compressed air engine and coal-cutting machine, 197

- Light, action of, upon sulphide of lead, by Dr. D. S. Price, 247; another new, 98; emission of, 343; mechanical equivalent of, 129
- Lindner's breechloading cannon, 35
- Literary and Philosophical Society, 393
- Living bodies dyed by aniline, 327
- Locomotives, manufacture of American, 344
- London new water supply, 246
- Looms for weaving, improved, 5
- Lunar photographs, 284
- Jaugler's steam engine, 103
- MACADAM, Dr., asparto fibre or Spanish Grass, 190
- M'Kay's transcrew for Geneva watches, 363
- MacKenzie's rollers for drawing fibrous materials, 116
- M'Naught's washing and drying wool machine, 394
- Maddison, P. W., on pumping engines, 69
- Magnesia, hydraulic properties of, 390
- Magnesium as the positive element of voltaic batteries, 263; thermic equivalent of, 18
- Magnetical dip instruments, 21
- Magnets, compassing and adjusting, 88
- Manganese ores in Nova Scotia, 327
- Manure, manufacture of, 380
- Markham, O. R., on a Polar expedition, 180
- Marley, Mr., on safety cages, 69
- Martin, opening and closing carriage-heads, 248
- Matches without phosphorus, 82
- Maynard's machinery for cutting agricultural produce, 250
- Mercurial air pump, Professor Poggenorff's new form of, 130
- Metallurgies, introduction of, into commerce, 82
- Metalloids not simple bodies but compound, 326
- Metals, in cerite and gadolinite, 67; polishing, 104
- Microscopology, 148
- Microscopic examination of Atlantic mud, 327
- Mineral wealth of the Island of Sardinia, 84
- Minerals, utilisation of waste, 259
- Minimetric analysis, by Dr. A. Smith, 36
- Miscellaneous, 11, 26, 41, 58, 74, 89, 105, 121, 137, 154, 169, 186, 201, 221, 238, 253, 285, 302, 318, 334, 350, 366, 385, 398, 411
- Monroe's heating steam boilers, 135
- Morgan's iron-converting machinery, 150
- Motion of advance of a shot down the bore of a gun, 243
- NAPHTHALINE, benzoic acid from, 129; industrial application of, 129
- National defence, our, 339; Rifle Association, 317
- Nature of the invisible photographic image, 246
- Naval and hydrographical telemetry, by Dr. A. Garlt, 359; and military signalling, 79
- Navigation of the Thames, 96
- Naylor, W., improved safety valve for steam engine boilers, 297
- Negative slip, 389
- New method of employing sunshine, 246
- Newton's manufacture of printing type, 54
- Night balloon ascent, Glasgow's report of, 236
- Nitrobenzol, poisonous properties of, 327
- Nitrogen, alleged compound nature of, 328
- Nitro-glycerine for use in blasting, 146
- Notes on new discoveries, 3, 18, 34, 50, 66, 82, 98, 129, 146, 194, 210, 222, 262, 271, 293, 309, 326, 343, 359, 373, 389
- Notices of books, 17, 128, 177, 324
- Nurse, F. F., sugar-making machinery, 211, 232
- OBITUARY, 184
- Olmstead's friction pulley, 151
- Opaque objects, illumination of, by Mr. Dancer, 298
- Ordnance, wrought-iron, 384
- Ore, a new metalliferous, 332
- Oster, A. F., variations in the motions of the air, 119
- Oxygen as a means of economising the consumption of coal gas, 34; method of obtaining, 18
- Ozone, atmospheric, 390; the density of, 358; v. nitric acid, 34
- PADDLEWHEEL engines, 65
- Paper as a material for sugar moulds, 50; pipes, 49, new material for, 263
- Papers, engineering, 1
- Paraffin lamp burners, 103
- Paris Exhibition of 1887, 261; Universal Exhibition, 197
- Parsons' machine for seedling and breaking flax, 23
- Passage of the earth through the tail of a comet, 359
- Patent laws, the, 95
- Peace Jubilee, the, 73, 88
- Pendred, V., adhesion of locomotive engines, &c., 294, 311
- Peroxide of iron, use of, for obtaining oxygen, 210
- Petroleum casks, 183; in Flintshire, 329
- Phenomena by the evaporation of mixed liquids, 263
- Phillips's girder and fireproof flooring, 391
- Phipson, Dr., siltium in iron, 163
- Phosphorescence, new cases of, 310
- Phosphorus, alleged new compounds of, 343
- Photographic tests, 51
- Photographs by mechanical means, copies of, 195; enamel copies of, 210; permanency of, 151; vitrification of, 60
- Piston rod guides, 193; valves, &c., 368
- Pneumatic despatch, 291; railway, 231
- Polar expedition, proposed Russian, 380
- Prece's electric signals, 52
- Prentice, Mr., progress of gun cotton manufacture, 219, 231
- Pressure piston packing, 285
- Printing on a new principle, 194
- Pseudoscopic vision, by J. B. Dancer, F.R.A.S., 23
- Pulley-blocks, Weston's differential, 397
- Punched or drilled holes in boiler work, 15
- RAHN'S patent dentoscope, 185
- Railway, an Anglo-Indian, 96; bridge, large iron, 345; companies and public telegraphs, 104; East London, 261; shackle, new, 184; train communication, 101
- Railways, pneumatic v. locomotive, 307
- Rain gauges, 144
- Rankine, Professor, resistance of water to floating and immersed bodies, 165; thermodynamics, 167
- Reduction of potassium by means of aluminium, 229
- Researches on indium, new, 229
- Reverberatory furnaces, 49
- Riband-shaped conductors for voltaic currents, 229
- Rice's wheels and axles, 199
- Rifle trial, 116; 7-in. guns, the rival, 405
- Rifled gun competition, 191; guns, the force giving rotation in, 208
- Rifles, converted Enfield, 143
- Road steam carriages in India, 131
- Roberts's screw propeller shaft thrust, 102
- Rod guides, piston, 193
- Roland, O., parkesine and its properties, 163
- "Royal Alfred," the, 345
- Rooke's double cylinder expansion engine, 298
- Rubidium and caesium, new sources of, 343
- Rubies, artificial, 229
- SAFETY gunpowder, 63; valve balance, 218
- Sawmill, improved, 87
- Scientific illustration, 32, 47; discussions, 380; witnesses, 53
- Scott v. the French gun, 175; W. S., action of alkali metals on gun cotton, 196
- Screw engines, 80
- Sea, observations on the transparency of the, 66
- Shipbuilders' Association, Scottish, 116
- Shipbuilding, improvements in, 86; progress of iron, 308
- Ships, applying motive power to, 40; bottoms, competition for preserving, 9; construction of, 86; displacement from the drawings, rapid mode of finding a, by W. Merrifield, 311; plates, moulding, 138; longitudinal strength of, 82
- Siemens, C. W., on deep sea cables, 162; regenerative gas furnaces, 365
- Signalling at sea by the magnesium light, 35; naval and military, 79
- Signals, Colomh's flashing, 84
- Sleigh's hydrostatic rotary engine, 101
- Smith, Dr., carbonic acid, 184, 388
- Smithfield Club Show, 371, 388
- Smith's centrifugal apparatus, 183; illuminator for opaque microscopic objects, 282
- Smithsonian Institution, the, 99
- Smoke consumption, 97
- Smyth, J., on ozone, 106
- Society of Engineers, 409
- Soda from cryolite, 390
- Sodium with mercury for extracting gold and silver from their matrices, 3
- Solly, N. H., gun-metal tuyere for blast furnaces, 297
- Spinning machinery, 57
- Spiral railways, 117
- Stahlschmidt, Dr., on the combination of iron with nitrogen, 66
- Steam boiler explosion, 367; incrustation, 161; carriage, improved, 260; ferry boats for Glasgow Harbour, 329
- Steel, cutting hard, 73; manufacture, 31; of cast, 168; rails, 200
- Stewart, H., magnet storms, 162
- Stone, artificial, 83, 184
- Street railway bridges, 313
- Sugar-making machinery, P. F. Nutey, 211, 289
- Sulphur in the atmosphere, 293; plasticity of, 299; value of, in the Swansea copper smelter, 220
- Sunshine as a source of mechanical power, 5
- Surface condensers, 127
- Suspending vehicles, 132
- Symons, G. J., rainfall of the British Isles, 179
- Synthesis of formic acid, 810
- TANNING, 262
- Target, the "Hercules," 379
- Telegraph cable, failure of the Atlantic, 112; the Atlantic, 31, 47, 95, 111, 143, 403; the Indian, 127
- Telegraphs and railway communications, public, 104
- Thallium, new sources of, 310
- Thames, navigation of, 96
- Thermoelectric battery, the new, 3; batteries, new elements for, 293; sulphide of copper, 98
- Tin on contact with a hydrogen flame, appearance of, 310
- Titaniferous iron, 315
- Torpedo, the electrical, 5; trials, 213, 136
- Townsend's improved lubricator, 17
- Trost's researches on zirconium, 68
- Tunnel, the Chicago, 117; Hoosac, 275
- Tungsten on cast iron, influence of, 146
- "Turkish," the, 281
- UNIVERSAL diffusion of copper, 293
- Utilising the heat of the earth, 332
- Utilisation of waste minerals, 259
- VEGETABLE oils, extraction of, 358
- Ventilating railway carriages, 34
- Voelcker, Dr., on recently discovered phosphoric deposits in North Wales, 196
- WALLING, H. F., on gravitation, and its relation to universal force, 264
- Water as fuel, use of, 311; gas for the Lenoir engine, 59; the incompressibility of, 165; trough, rotary, 379; troughs for cattle troughs, 214; the analysis of, 133
- Watt and Boulton, 366
- Weatherley's paper-sizing machine, 267
- Weekly meetings, 288, 302, 318, 334, 350, 366, 385, 398, 411
- Weems's engine governors, 118
- Weight of portions into which matter can be divided, 349
- Weldless tyres, circular, rolling, and railway wheels, by F. J. Bramwell, 213
- Wenham, F. H., fracture of polished glass surfaces, 265
- Westmeath's hydraulic cranes, 4
- Weston's differential pulley-block, 387
- White inoxidable alloy for taps, 246
- White, W., on photography, magnesium, and the pyramids, 179
- Wilson's improvements in pumps, 118
- "Winoski" and "Algonquin," trial of, 327
- Winton's reaping or mowing machine, 151
- Wool, chemistry of, by Professor Anderson, 85
- ZINC, engraving on relief in, 129
- Zirconium, method of reducing, 246

ILLUSTRATIONS TO VOL. XIV.

- Agricultural machinery, Hall's, 268; railways, 314
- Armour-plated ships, 79
- Attachment to steam boilers, Riordan's, 20
- Ball and jet, the, 381
- Beer pumps, Jackson and Giholm's, 251
- Blast furnaces, Caubham's, 341; for the manufacture of pig iron, 22
- Boiler, feed-water apparatus, Valant's, 346
- Bolts for shipbuilding, 70
- Boot-making machinery, Danleah's, 134
- Breech-loading cannon, Lindner's, 35
- Brick-making machinery, Axton's, 216
- Bridge over the Niemen at Kovno, 216; Scheldt at Anderna, 7
- Calorimeter safety valve, 328
- Candles, manufacture of, 116
- Casting steel, Benson's, 194
- Centrifugal apparatus, Smith's, 183
- Chimney tops and ventilators, Tyler's, 21
- Cleaning iron ships afloat, 163
- Clyde steam dredgers, 26, 39
- Combination ratchet brace, 365
- Combined drill, vice, and lift, Hodgson and Pitt's, 315
- Combustion of fuel, facilitating the, 408
- Compound guns, 317
- Compressing gunpowder for blasting, 265
- Connecting rods, 275
- Cutting agricultural produce, Maynard's machinery for, 250
- Dentoscope, Rahn's, 185
- Distilling hydrocarbons, Ormack's, 182
- Diving mask, Hawkins's, 4
- Double cylinder engine, 73; expansion engine, J. Rooke's, 293
- East London Railway, 261
- Electric signals, Prece's, 52; telegraph protectors, 100
- Electro-magnet locomotive, 232
- Engine governors, Weems's, 118
- Fan blowers, Ager's, 331
- Fire and burglar alarm, 219
- Friction of engines, 161; pulley, 151
- Force giving rotation in rifled guns, 209
- Funnel and measure combined, 69
- Furnaces, Durand's, 409
- Giffard's injector, 395
- Granite and iron fortifications, 349
- Gyroscope, Clark's problem, 365
- Heated air engine, 347
- Heating steam boilers, Monroe's, 135
- High speed compressed air hammer, Grimshaw's, 330
- Hydrostatic rotary engine, Sleight's, 102
- Hydraulic cranes, P. G. B. Westmeath's
- Hydrants, 68
- Improved steam carriage, 201
- Iron converting machinery, 150
- Lamp burners, paraffin, 103
- Lock-jaw cotton gin, Cowper's, 214
- Looms for weaving, 6
- Lubricating cylinders, Drury's, 214
- Lubricator, improved, 71
- Machine for seedling and breaking flax, Parson's, 23
- Mercurial air-pump, a new form of, 136
- Motion down the bore of a gun, 244; in a circle, 10, 24
- Motive power, improved, 68
- Naval and hydrographical telemetry, 360
- New piston valve, 363
- Opening and closing carriage-heads, 248
- Oscillating steam valve, Dr. Carhart's, 132
- Paper-sizing, Weatherley's, machine, 267
- Parallel jaw vice, 379
- Postage stamp and gum label affixer, 381
- Printing type, manufacture of, 54
- Puddling iron by machinery, 166
- Pumps, Wilson's improvements in, 118
- Punching machines, Baylies's, 199
- Rails and railbearers, 167
- Railway carriages, Claxton's improvements in, 105; turntables, Greenway's, 132
- Rain gauges, 169; K. H. Clark, 237
- Reaping machines, Brenton's, 9; or mowing machines, 151
- Recoiling magnet, 299
- Rollers for drawing fibrous materials, MacKenzie's, 116
- Rotary water trough, 379
- Safety valve balance, 248
- Saw mill, improved, 87
- Screw propeller shaft thrust, 102
- Self-rotating syphons, Devereux's, 183
- Shipbuilding, improvements in, 87
- Ships, construction of, 86
- Siemens's furnace, 282, 283
- Signals, Colomh's flashing, 84
- Spinning machinery, 57
- Steam engine, Hicks's, 45; Lumley's, 103
- Sugar-making machinery, 224, 235
- Suspending vehicles, 132
- Telemeters, or instruments for measuring distances, 260, 296
- Tubular boilers, Ames and Anderson's, 362
- Turnscrew for barrel centres, M'Kay's, 363
- Variable speed, 278
- Washing and drying wool machine, M'Naught's, 394
- Wave-line theory, 121
- Wheel and axle, Rice's, 199
- Variations of the reading of the barometer, 292

THE
MECHANICS' MAGAZINE.

LONDON: FRIDAY, JULY 7, 1865.

THE AMES GUN.

THE Ames gun once attained some celebrity in America owing to the powers of endurance manifested by some which were severely tested at the Washington Naval Ordnance Yard and elsewhere. For many years past there have been numerous, though unsuccessful, attempts to make good wrought-iron guns of large calibre. All sorts of possible and impossible methods of manipulation have been tried, but, up to a comparatively recent date, the results have only been failures, more or less complete in their character. As far as relates to guns of small calibre a little more success has attended the efforts of inventors, and wrought-iron field pieces are now in general use in the American army. But this success does not appear to have led to the satisfaction of the want which still exists for a gun of large calibre possessing sufficient means of endurance to make it a reliable piece, and which wrought iron might naturally be expected to furnish. Mr. Ames, of Connecticut, however, appeared at one time to have triumphed over all difficulties, and to have produced a wrought-iron gun which fulfilled all the requirements of modern artillery. By his process the size and calibre of the piece appeared to be a matter in a great measure independent of the practical difficulties of fabrication. His small bores, such as 5-inch guns, were so unburstable that it seemed as though nothing could step in between them and perfection as regarded endurance. But, on applying the principle to ordnance of a larger calibre, something was lacking, for he does not appear to have been more successful than his predecessors in the wrought-iron large-bore line. The Ames gun is formed by welding together in succession a series of wrought-iron discs and rings. The discs are used to form the solid portion of the gun at the breech, and the rings that portion containing the bore. The construction of the gun is commenced at the caseable. The rings for forming the largest part of the gun are each compounded of three concentric rings, accurately turned and fitted together. These compound rings are turned to precise shape on their faces before the final welding to construct the gun takes place. The centre or inner ring projects slightly beyond the plane of the other two, in order to render certain the perfection of the welding next the bore.

Some of these guns have been put to very severe experimental tests at the Washington Naval Ordnance Yard, as already observed. One rifled 50-pounder, weighing 5,613 lbs., calibre 5.1 inch, density 6,761, and tensile strength 66,175, was fired with 3½ lbs. of powder and shell and shot weighing 37½ lbs. The firing was stopped at the 1,600th round; according to the official report it was discontinued on account of rapid increase of vent. The vent was not bouched, and no further trial of its endurance was made, so that practically the real merits of the piece remain unknown. In the report it is stated that a cast-iron 30-pounder stood 2,000 rounds without bursting, the model being the same as the gun made by Mr. Ames. This would lead to the inference that the Ames gun had been tested to its limit of endurance. But the record does not show this to have been the case, and it by no means bears out such a supposition. Another of Mr. Ames's guns, of the same dimensions as that just referred to, but bored for an 80-pounder, was also tried at the Washington Naval Yard. The trials stopped at the 438th round, but the gun did not burst. It may be here observed that the Parrott 100 and 200-pounders on Morris Island at the siege of

Charleston sustained on the average only 310 rounds each before giving out. This is the working average, and is exclusive of those in which the bursting could be traced to the premature explosion of a shell. In another instance an Ames 50-pounder—an imperfect gun—was tried at the foundry in Connecticut with the view of bursting it; the piece rested on skids, eight inches above the ground, and the following tests were applied:—First round, 12 lbs. of powder and a 100 lb.-ball; second round, 16 lbs. powder and a 300-lb. ball; third round, 20 lbs. powder and a 450-lb. bolt. At this shot the gun recoiled 30 ft. from its supports, and the bolt went through two mounds of earth 10 and 12 ft. thick respectively, and then 80 rods beyond. The fourth round consisted of 20 lbs. of powder and a 200-lb. bolt, loaded so that the bolt projected from the muzzle one inch, with the end firmly resting against a block of cast-iron weighing 2,800 lbs. The gun recoiled 60 ft., the cast iron block—which was 36 in. × 20 in. × 20 in.—was sent through a bank of earth 12 ft. thick and 40 ft. beyond. These severe tests produced no visible effects upon the piece, and did not appear to have impaired its powers of endurance. The Ames gun costs about 85 cents per pound, in the largest gun, which is about 7 inches calibre, and weighs 19,400 lbs.; the cost is about six times that of Parrott's 8-inch rifle. But if on trial a gun of large calibre fulfilling all the requirements of service should be found to be produced by Mr. Ames's peculiar method of forging, its cost would scarcely be deemed an insuperable objection to its adoption. In wrought-iron guns the tensile strength and the ductility of the metal are both brought into play. The bore of the gun in firing rapidly receives a permanent enlargement within the limit of rupture. To a certain extent the piece is thus strengthened, inasmuch as the surrounding metal is placed under tension. The bore is thereby hindered from stretching further, beyond the power of the metal to stand. After the first fifty rounds, if fired with heavy charges, there is but little enlargement of the bore in wrought-iron guns. They might be advantageously bored a trifle smaller in the first instance than the ultimate calibre, and then fired with a few heavy rounds, after which they should be finally bored to the proper diameter.

So far, then, all seems satisfactory with regard to Mr. Ames's system in guns of moderate calibre, but the matter assumes a different aspect when viewed with relation to guns of large bore. Some three months since it was reported that one of Mr. Ames's large-bore wrought-iron guns had failed, by being torn apart through one of the numerous transverse welds which run entirely across the gun. From the previous description, it will be seen that these welds are unavoidable in this method of manufacture. It is just possible that they will prove an insuperable barrier to the construction of a really sound and serviceable gun of large calibre on this principle. According to the *New York Army and Navy Journal* another of these guns has failed on the first round, and in a precisely similar manner to the first one. The gun was fired with a charge of 25 lb. of powder and a 125-lb. projectile, and the result was a complete severance of breech from muzzle through one of the transverse welds. In manufacturing his guns Mr. Ames sets aside all notion of anything like a scientific method of procedure. His own account is that, in the first place, he simply takes the best iron and makes it in the most perfect manner. He then bends and welds the rings, turning and boring them so that they fit perfectly, and when this is all well done the rings are welded to the gun solid and sound, the gun being then bored, turned, and rifled. By these means Mr. Ames claims to make "the longest range gun, the strongest gun, both lengthwise and crosswise, and the most enduring gun known." It is conceded on all hands

that the wrought iron used at Mr. Ames's works cannot be excelled in quality; therefore so far Mr. Ames's statement is borne out by fact. But it is a different thing when the character of the gun comes in question. Of course no more satisfactory results could be obtained from guns than those we have referred to at Washington and at Mr. Ames's works, and these are not the only examples of the endurance of these guns. But it has to be remembered that these were comparatively very small guns, and, whatever may be the cause, it does not seem that Mr. Ames's gun on a large scale turns out as good as his iron. His observation, that the iron is made into a gun in the most perfect manner, does not yet hold good beyond the 5.1-inch bore, which, by the way, was very heavy in proportion to the calibre, weight of charge, and projectile. Taking the two cases of failure before us into consideration, there is very little room to doubt that, however correct the theoretical principle of the gun may be, the method of manufacture is at variance therewith. In each case the gun gave out through one of the numerous transverse welds, which extend entirely across the gun and into the bore, where the rings forming the gun are joined together. Now there is a liability in any one of these welds to give way through imperfect work. But there lies at the root of the whole matter something even more important than this. In making these guns the rings, as we have said, are brought to a welding heat, and this very circumstance must destroy the fibre of the iron, and so ruin its character. The very principle upon which scientific gunmakers depend for strength—continuity of the fibrous character of the material throughout the piece—is here absent, and the failures in question are clearly referable to this evil. Guns of less than 13 or 15 inches are of very little use now in naval warfare, and it seems clear that pieces of this calibre are not obtainable by Mr. Ames's principle. To be of any service, too, a gun should stand not less than a thousand charges of powder, the charge being as large as is consistent with useful effect. If, however, guns of heavy calibre cannot be turned out on the Ames principle—and there appears but little hope for it under existing conditions—it were better to confine this special manufacture to small bores, where it appears eminently successful. But the failure of the Ames large-bore gun cannot be accepted as a proof that the production of heavy wrought-iron or steel guns is a thing impossible. Neither does it afford a plea for decrying that class of guns, when made upon a sound principle and with good workmanship. The necessity for obtaining greater and more reliable strength than can be realised by the use of cast iron is unquestionable. It therefore only remains to pursue the question carefully and assiduously, until a wrought-iron or steel gun be produced which shall equal the 15-inch cast-iron gun in calibre, and excel it in power, both of projection and endurance.

ENGINEERING PAPERS.

IF scientific bodies as well as individuals are to be known by their fruits, and if the test be applied to the Society of Engineers, no difficulty will arise in assigning to that institution a very high position in the order of merit. The fruits it has brought forth in the past year are certainly not wild grapes, and, judged thereby, the society must stand in an enviable relative position with respect to some of its contemporaries. These remarks apply with additional force when the comparatively recent date of the society's formation is taken into account, and it is by no means uninteresting to trace its growth—as we may do—by its annual productions. The society, as the title-page of the volume before

* Transactions of the Society of Engineers for 1864. London: E. and F. N. Spon, 16, Bucklersbury, 1865.

us states, was established in May, 1854, when some half-dozen professional gentlemen met together at stated periods to discuss matters of scientific and general interest. Since then its numbers have gradually increased, until the present year finds the members numbering some 360 strong. It is not, however, our intention to go into the history of the society; that has been already done in our columns. But we will simply notice the increase in its literary importance as evidenced by its yearly publications. Its literary career may be said to have commenced in 1857, when its proceedings for the previous year were published, and which were by no means incommensurate to the waistcoat pocket. A year later it was able to indulge in thirteen pages 12mo., which contained rules, list of members, and the abstracts of seven papers, the latter being very scanty. The Transactions for 1858 were of the same character as the last, but they extend to seventeen pages. In the following year the abstracts were printed at greater length, and notes of the discussions were appended, increasing the volume to forty pages. In 1860 a further increase of thirty-four pages brought the book up to seventy-four pages, one of the papers being illustrated with a page woodcut. The Transactions for 1861 and 1862 contain respectively 125 and 193 pages, the illustrations both on wood and stone increasing in the same ratio, whilst the volume for 1863 counts 218 pages, and is accompanied by numerous folding plates. This steady increase in quantity has not been unaccompanied by a corresponding increment in quality, which, after all, is the best criterion whereby success may be judged.

But returning to the volume of Transactions for 1864, we may observe, first, that it has increased in size to 8vo. and in bulk to 267 pages, each paper being fully illustrated with numerous well-executed lithographs. Here the improvement in the character and tone of the papers is certainly very marked, and denotes a degree of care in preparation alike worthy of the society and of the subjects treated. The authors of the nine papers have certainly shown as much good taste in the selection of their subjects as they have skill in elaborating them. They all bear very closely on some of the most important engineering questions of the day, and embody much sound, practical information. The first paper is one on Fuel, by Mr. Perry F. Nursey, and which has reference principally to the relative powers of coal and condensed peat for giving heat. The paper treats generally the natures and properties of various kinds of fuel, both natural and artificial, and embodies the well-authenticated results of such investigations as have been made with the view of ascertaining their economic values, their comparative evaporative powers, and their theoretical and actual duties. Following out these views, the author considers successively coal, coke, peat, and compound or patent fuels. Mr. Nursey proves, from well-authenticated data, that the heating power of condensed peat is more than that of coal in the proportion of about two to one. In view of the immense stores of peat in the British Islands, and bearing in mind the exhaustible character of our coalfields, the matter is certainly worthy of consideration. Diagrams of various coke ovens and of some peat machinery are appended. The succeeding paper is by Mr. A. F. Wilson, and forms an excellent treatise on the manufacture of coal gas. The author ably describes the process of gas making as practised in the present day, giving *seriatim* careful descriptions of the plant and machinery used in the process, and naming the best coals now employed for its production. Coals from the following mines are now generally employed by gas companies in the metropolis and surrounding district:—Pelaw, Levenson's Wallend, Pelton, New Pelton, Deane's Primrose, Garesfield, South Peareth, Urpeth, Washington, Yorkshire, Silkstone, Haswell, West Wear, Wearmouth, Brancepeth, South Brancepeth, and Ravensworth Pelaw. The

resulting products of carbonisation of these coals, when an exhauster is employed, will be found to give about the following average per ton:—gas 9,500 cubic feet, coke 13 cwt., or one chaldron, tar 10 gal., and ammoniacal liquor 13 gal. In these the quantity and quality of gas do not vary to any very extensive degree. The author describes the entire manufacture of gas, following it from the retort house, through the various processes, to the governor, and beyond that, through the mains, to the consumer's meter. Both the paper and the discussion which follows will be found exceedingly valuable to all interested in gas matters, the whole being accompanied by a set of general and detail illustrations of the entire apparatus used in gas making, testing, and burning.

Mr. A. Fraser's paper on the use of the Cornish pumping engine follows next in order. Here we have a carefully compiled history of the Cornish engine, and an able description of it as now used. Mr. Fraser enters fully into a comparison of the relative merits both as to cost and expense of working the Cornish engine, and the high pressure expansive rotary engine. He is evidently strongly of opinion that the falling off in duty of the Cornish engine of late years is due to the inferior quality of the coal used, and supports his arguments by the following fact:—At the waterworks, at Kew Bridge, a 90-inch cylinder Cornish engine was worked for several days from five boilers burning the best coal that could be procured, costing about twenty-five shillings per ton. The duty performed was ascertained to be one hundred and five millions. The fuel in general use is small coal, costing ten and ninepence per ton, and the average duty with this is sixty-two to sixty-five millions. Mr. Fraser's opinion is in favour of the Cornish engine, although, in a very lengthy and valuable discussion which followed, a contrary opinion is for the most part observable, the majority of the speakers being in favour of the high-pressure, and regarding the Cornish engine as adaptable only for exceptional works. And this is really the true state of the matter, for there are circumstances where the Cornish engine is admissible, but it cannot, or rather should not, be applied indiscriminately. In the discussion Mr. W. T. Carrington, the present president of the society, gave an elaborate description of the pumping engine of the Brooklyn Waterworks in America. A great mistake was made in designing and constructing this engine, which afterwards had to be rectified at great cost before it could be made to work with any efficiency. In a paper on elastic railway wheels, Mr. Vaughan Pendred most ably describes the requirements for an elastic medium between the rails and rolling stock of railways. He shows that the repairs to the permanent way alone average in Great Britain nearly 15 per cent. of the total working expenses, costing in England about £220, in Scotland £142, and in Ireland about £84, per mile per annum. To sum up what Mr. Pendred advances respecting permanent way:—Conventional elastic way is more expensive in maintenance than true rigid way. Conventional rigid way is more expensive in maintenance than conventional elastic way. Most, if not all, forms of rigid way are more destructive to practically rigid wheels than almost any form of elastic way. The author shows that the idea of an elastic wheel is by no means new, but that from the first it was always sought to gain this point, but by very variable means. With regard to the saving in tires and rails, Mr. Pendred shows how well this is effected by the use of Mr. W. B. Adams' method of placing the elastic medium between the tire and the rim of the wheel. Tires of Staffordshire iron on springs have run a distance of 104,000 miles with very little wear, whilst tires of Low Moor iron rigidly seated on the same class of wheel were completely worn out in running the same distance.

Considered from a practical point of view, perhaps one of the most valuable papers in the book is that by Mr. M. Parkes on the wrought-iron road bridges of the Charing Cross Extension Railway. It gives an exhaustive account of the construction of all the bridges. Commencing with a brief sketch of the line and a general description of the whole of the works, the author goes on to describe in detail each bridge in succession. There have been three types of structure employed—the single web girder, the box girder, and the bowstring girder. In all the bridges on the Charing Cross Railway a clear roadway, the full width of the bridge, has been secured. Excepting the Borough Market viaduct, this has been obtained by the two following methods:—First. In the case of spans up to (say) 50 ft., by placing shallow girders immediately under the rails for the working girders, the two-face girders, which have riveted to their upper flanges a sheet-iron parapet, being of lighter section. Second. In the case of larger spans, the roadway has been formed by attaching cross girders to two main girders. The following are the three systems of road-plating employed:—First. For the small spans, wrought-iron arch plates $\frac{1}{2}$ in. thick, are riveted to the top flanges of the girders. Second. For the larger spans, when the line is straight, longitudinal plates 16 in. $\times$ $\frac{1}{2}$ in., centred with the rails, extend from end to end of bridge; they are riveted to the cross girders; then, arch plates, $\frac{1}{2}$ in. thick, are riveted to their sides. Angle-irons, $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{4}$, are substituted for the longitudinal plates at the sides of the bridge. Third. For the preceding case, when the line curves, the cross girder has riveted to its upper flange a $\frac{1}{2}$ in. plate, 5 in. wider than flange, and centred with it. The space between two cross girders is then filled in with flat plates, $\frac{1}{2}$ in. thick, riveted to plates on upper flanges of cross girders. To the paper is appended a detail description of the Hungerford Railway Bridge, giving the dimensions of all the parts of the bridge, which is also done in the case of the road bridges, and in most instances weights are likewise given. The details of all the bridges are further illustrated in a set of carefully-prepared lithograph drawings, and the whole paper is a valuable addition to the records of engineering construction. This paper is followed by an interesting descriptive account of the Erith explosion and repair of the Thames embankment, written by Mr. Lewis Moore, who, residing in the locality, was one of the first to reach the scene of the accident. We believe it was owing to Mr. Moore's energy and decision that the fatal disasters which must have followed an ineffectual stoppage of the breach were averted, and a wide-spread inundation prevented. The paper describes and illustrates in detail the structure and arrangement of the various buildings used as powder magazines in the marshes adjoining the Thames below Woolwich. The author also gives particulars of the effects of the explosion, especially with reference to the imminent danger of inundation already referred to, and to which no less than four thousand acres of land, covered with habitations, were exposed by the partial destruction of the Thames embankment.

The two concluding papers are practically one, being by the same author, and upon the same subject. Mr. Baldwin Latham's name is already familiar to engineers in connection with the drainage of the Fens of Lincolnshire, and the repair of the ruptured sluices in 1862. He has in the present instance written two most elaborate papers on the supply of water to towns. The author inquires into the various methods that have been, and that are still, adopted, to furnish supplies of water to large cities or towns, and as all supplies are furnished by the rainfall this part of the subject is first treated of. Following it, the various sources of supply are dealt with in order as they are more immediately connected with it. A tabulated statement of many years'

observations of the rainfall, in more than one hundred and thirty different localities in Great Britain, is given, which will prove of great practical value to the engineer having to deal with the question. The circulation of water, its evaporation and absorption, are successively noticed, and the rainfall collected from roofs, water supplies taken from collecting areas, and the quantity and quality of such water, are fully discussed. Examples of eighteen waterworks supplied from drainage areas are given, the geological character of the formation and the rainfall of the district being noted. The rainfall is shown to vary considerably in different localities. Thus at Ashton in Lancashire it is 40 in., at Bolton 50 in., Belfast 32 in., Dublin 45 in., Dukinfield 36 in., Glasgow 60 in., Greenock 60 in., Huddersfield 33 in., Liverpool 55.5 in., Macclesfield 40 in., Manchester 37 in., Oldham 35 in., Paisley 56.33 in., Plymouth 44 in., Preston 43 in., St. Helens 30 in., Southampton 23 in., and Wigan 40 in. The amount of rain falling on elevated localities is more than on low table land. A consideration of the water supply taken from rivers and streams concludes the first paper, or rather section. The second section opens with a notice of the supply of water to towns from natural springs, the different kinds of springs and their respective yields being fully discussed. Wells, and well-sinking and boring, are next treated in a very ample manner, the author giving particulars of all the principal wells in the world. He cites Joseph's well at Cairo as a fine example of the skill and boldness of design of the well-sinker. Although called after Joseph by the Arabs, this well is by no means of so ancient a date as the name would imply, for the well was probably sunk about 700 or 800 years ago, but by whom is a disputed point. The temperature of water taken from the bowels of the earth is somewhat higher than that of waters found upon the surface. The rate of increase has been variously estimated; thus, Mr. Latham informs us that, in the case of eleven wells sunk in Scotland some years since, the mean temperature increased about 1 deg. Fahr. for every 48 ft. descent. M. Valferdin found that in some wells in Paris the rate of increase was 1 deg. for every 57 ft. descent. M. de Girardin found at Rouen that the rate of increase was 1 deg. for every 37½ ft. of descent, and in another case 1 deg. for every 55½ ft. descent, while careful experiments on the artesian well at Grenelle give an increase of 1 deg. for every 59 ft. descent. The mean temperature taken from the above observations would give a mean result showing that the rate of increase of temperature is 1 deg. Fahr. for every 52 ft. descent. The temperature of the water at the well of Grenelle, which is nearly 1,800 ft. deep, is 81.81 deg. Hospitals and public baths have been heated with this water. A very large amount of useful information is also given respecting the wells of London; in fact, utility is the quality which pervades the whole paper, which is amply illustrated. Upon the whole we may certainly congratulate the Society of Engineers upon this, their latest production, which will be found a useful addition to the library of every engineer. Of course, as in all works of this class, there is no external indication of the editorship, but we take it for granted that the credit in this respect is due to the secretarial department, and certainly the manner in which the work has been compiled reflects great credit on that branch of the executive. Nor can less be said for the publishers; the lithographs with which the book abounds are remarkably well got up. If it be not invidious to single one set from the rest, where all are equal in quality, we would refer to the drawings of the Charing Cross Railway bridges, which are remarkable for their clearness and minuteness of detail, the dimensions being carefully figured on every part in true engineering style. We heartily commend this volume to those in search of original information upon the varied subjects of which it treats.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

The Iron-Fuel Project—Casting Malleable Iron—The New Thermo-Electric Battery—Sunshine as a Source of Mechanical Power—Use of Sodium with Mercury for extracting Gold and Silver from their Matrices.

THE object for which M. Tellier proposes, as mentioned last week, to use iron as fuel, is that of obtaining a temperature sufficiently intense to fuse pure iron, and so to enable articles of malleable iron to be obtained by casting. He believes that, despite the expense of the metallic fuel by which he proposes to accomplish this object, pieces of mechanism in malleable iron could be produced by the method he suggests very much more cheaply than by forging. He is of opinion, too, that the iron fuel need not, after all, be very costly, since he would use as such only pig iron of the most inferior kinds—pigs which cannot be converted into good iron by any method at present practised,—and, in the process of burning, their sulphur and phosphorus, as well as their carbon, would form gaseous products with the oxygen in which the combustion took place, and would all fly off, leaving behind only pure oxide of iron, which, if afterwards smelted, would yield iron of the very finest quality. In what kind of furnace he would burn his iron fuel, and how he would apply the heat obtained to the pure iron he desired to fuse and cast, he has not explained. He calculates that to fuse a thousand kilogrammes of pure malleable iron, two hundred and seventeen kilogrammes of iron will require to be burnt, if the combustion of the iron fuel take place, as he proposes, in pure oxygen.

Professor Wheatstone has constructed a very powerful thermo-electric battery on the principle of that exhibited by Mr. Ladd at the Royal Institution, of which we spoke a fortnight ago. The battery constructed by Professor Wheatstone consists of sixty pairs of small bars, and its electro-motive force is said to be about equal to that of two of Daniell's cells. The battery was recently exhibited to a select circle of Professor Wheatstone's friends, and it is stated that "on connecting the terminals of this battery, excited as Marcus's, a brilliant spark was obtained, and about half an inch of fine platinum wire when interposed was raised to incandescence and fused; water was decomposed, and a penny electro-plated with silver in a few seconds, whilst an electro magnet was made to lift upwards of a hundredweight and a half. Bright sparks were obtained from the primary and secondary terminals of a Ruhmkorff's coil connected with the battery. In fact, all the effects obtained from a small voltaic combination were reproduced with ease by this thermo-electric battery." In constructing this battery, Professor Wheatstone found confirmation of the curious fact, first announced by M. Marcus, that the power of a battery of this kind is very greatly increased by frequently re-melting the alloys of which its elements are composed. This is supposed to be due to the repeated fusion breaking down the crystalline structure of the alloys.

Not unnaturally, this thermo-electric battery is exciting the imaginations of men of science, causing them to call up wonderful visions of a future when much of the work of the world shall be done by sunshine. Thus, a contemporary suggests that, "like windmills, thermo-electric batteries might be erected all over the country,—finally converting into mechanical force, and thus into money,—gleams of sunshine, which would be to them as wind to the sails of a mill. What stores of fabulous wealth are, as far as our earth is concerned, constantly wasted by the non-retention of the solar rays poured on the desert of Sahara. Nature here refuses to use her wonderful radiation-net, for we cannot cover the desert sands with trees, and man is left alone to try his skill in retaining solar energy. Hitherto helpless, we need not be so much longer; and the force of a Sahara sun may be

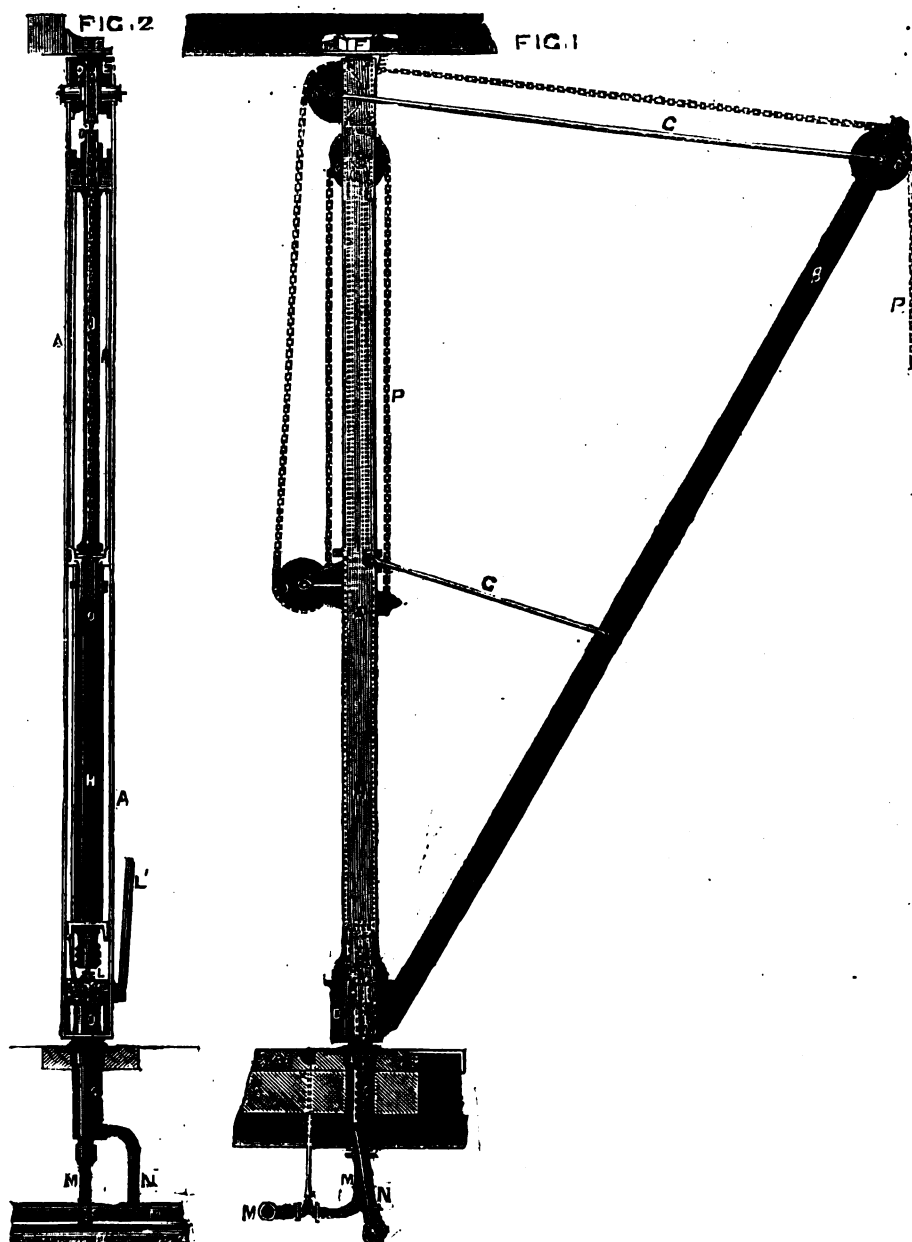
carried through wires to Cairo, and thence irrigate the desert, or possibly, if need be, it could pulsate under our streets, and be made to burn in Greenland." A fascinating dream enough,—and one which may prove to be "not all a dream."

In extracting gold and silver from their matrices by the process of amalgamation, the mercury employed often "sickens," and "flours." "Sick" mercury is mercury which has become tarnished at the surface by oxidation; "floured" mercury is mercury which has become tarnished by combination with sulphur. When triturated, in the amalgamating machines, with the rock from which the gold or silver is to be extracted, mercury tarnished by either of the causes mentioned "breaks up into minute particles, which will not again unite, and are carried off with the slimes, so that with many ores the loss of mercury forms a considerable item in the cost of extracting the precious metals." Mr. Crookes, however, the Editor of the "Chemical News," and the discoverer of thallium, has found that "by the simple addition of a small quantity of the metal sodium the sickening of mercury is entirely prevented, floured mercury is immediately brought together again, and the amalgamating action of ordinary mercury is greatly increased." Mr. Thomas Belt, who has experimented with sodium amalgam, at Mr. Crooke's suggestion, adds the following particulars. "It is found," he says, "that a surprisingly small amount of sodium is sufficient to effect the clearing of fouled mercury. It will require a longer series of experiments than there has yet been time to carry out, to determine the smallest effectual proportion, but it has already been proved that 1/50,000th part of sodium, added to the mercury, is amply sufficient, so that this discovery has the great advantage of cheapness to recommend it. Sodium may even now be obtained in large quantities for 5s. per lb., and if a demand were to spring up for it, its price would be greatly reduced; but calculating at the present price of the metal, and using the quantity that experiments have proved to be amply sufficient for any description of ore, the cost is a mere trifle, in comparison with the advantages gained. With the ordinary amalgamating troughs in gold mining, 120 lbs. of mercury are used to each set of four stamps, reducing 4 tons of quartz in twelve hours; and supposing the supply of sodium to be renewed every twelve hours, the cost would be less than 1d. per ton of quartz treated, which would certainly be more than covered by the loss of mercury prevented, without reference to the greater quantity of gold obtained, in consequence of the improved condition of the mercury." The sodium would seem to produce the beneficial effects thus indicated by virtue of its energetic power of reducing oxides and sulphides.

HYDRAULIC CRANES.

An invention having for its object improvements in hydraulic cranes has been patented by Mr. Percy G. B. Westmacott, of Elswick. Heretofore in hydraulic cranes the cylinder (or cylinders) of the hydraulic machinery has been separated from the crane itself, and carried upon an independent foundation or bed-plate. Now, according to this invention, hydraulic cranes are constructed in such manner that the hydraulic machinery is carried within the parts of the crane itself instead of attaching it away from the crane; and for this purpose the cylinder and ram are placed upon the pillar or jib of the crane, and the water supply pipe of the engine is conveyed up through the pivot upon which the crane pillar turns. The pillar or jib is, by preference, formed of two parallel plates of iron, having at their lower ends the hydraulic cylinder between them, and above the cylinder guides are formed on the plates to guide the ram in its to-and-fro movement; the length of the cylinder and ram will depend upon the length of the lift required. The ram at its upper end carries a pulley, over which the chain of the crane passes; one end of the chain is attached to the cylinder itself, and (when the cylinder is carried by the pillar) the other end of

HYDRAULIC CRANES.



the chain, after passing over the pulley on the ram, passes downwards, and then, after passing around a pulley below the top of the cylinder, rises upwards and passes over a pulley at the top of the pillar, and so over a pulley at the end of the jib. The water supply pipe, which rises up through the pivot upon which the crane pillar turns, as before mentioned, either passes to the cylinder, or if the valve be also attached to the crane as it should be, it passes to the valve, and so to the cylinder. It is preferable also that the pipe should pass through the lower pivot, as by so doing advantage can be taken of the pressure of water acting on the area of the supply pipe passing through the pivot to ease or relieve to that extent the weight of the parts revolving upon the bottom socket, and thus enable the jib to be turned with greater ease. By constructing hydraulic cranes in the manner above described not only is there a saving in the space occupied by the machinery, but the cost of the crane and foundation required for it is also diminished.

Fig. 1 in the illustration shows a side elevation of a crane constructed and worked according to this invention; fig. 2 shows a back elevation thereof. A A is the pillar composed of parallel plates; B is the jib; C C are the stays; D D is the bottom pivot on which the pillar turns; E is the top pivot; F is the top socket; G is the bottom socket; H is the hydraulic cylinder, carrying the pulley O, and the cylinder has also one end of the chain P attached to it; I is the ram which carries the pulley O', over which the chain P passes, then under the pulley O, thence over the pulley O', and then over the pulley O' at the upper end of the jib. The length of the hydraulic cylinder and ram and the number of the multi-

plying pulleys will depend on the length of lift required. K K are the guides for the ram; L is the valve for working the ram; L' is the handle for working the valve; M M are the pressure pipes; and N N are the exhaust pipes. It is preferred that the pivot which works in the bottom socket should be made with a vessel or cistern to receive the exhaust water from the cylinder, as also the drainage water before passing through the bottom socket to the exhaust pipe or drain, and it is also preferred that the water for working the hydraulic cylinder should pass through the bottom pivot, but if desired it may pass through the upper pivot, or be otherwise supplied to the hydraulic cylinder.

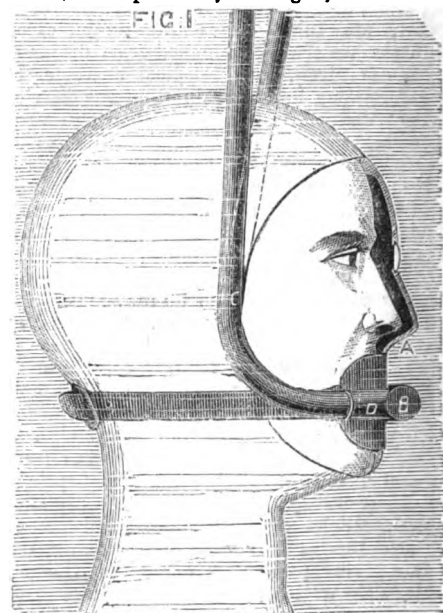
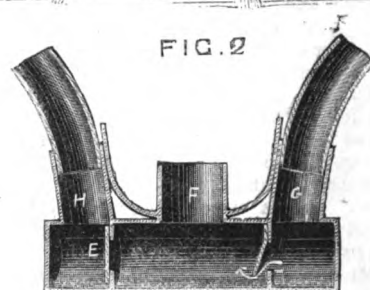
HAWKINS'S DIVING MASK.

At page 312 of our issue for the 19th May last, we described and illustrated M. Galibert's respirateur for enabling persons to breathe freely under water and in vitiated air. We have just received from America particulars of an apparatus for a similar purpose, but which we think is simpler in its use, inasmuch as the valves are self-acting instead of having to be worked alternately by the tongue as in M. Galibert's respirateur.

This invention, which has been patented through the Scientific American Patent Agency, by Mr. James Hawkins, of Braddock's Field, Pa., is intended to assist the respiration of divers, or persons exposed to noxious gases, foul vapours, smoke, &c. By the use of it fresh air can always be led to any point where the atmosphere is vitiated. Thus, in diving—going to a depth below the surface of the sea—great difficulty is

experienced in breathing, as is commonly known, and fresh air has to be pumped or forced down to persons who follow such calling.

The engravings represent a contrivance for regulating the admission of pure and the exit of foul air to and from the lungs. To this end the mask is fitted with a T-shaped tube B, which has pipes C issuing from its branches D. In the T there is a compartment, as in fig. 2, in which the



valves E fit. The mouth-piece is at F, and it will be seen that as the cold air is forced down or falls by its gravity in the pipe C, the heated air expelled from the lungs rises naturally through the valve H, thus rendering exhalation and inhalation comparatively free, and separating pure from foul air. This device would be useful in foul wells where carbonic acid gas collects, in cesspools, or in similar places.

THE STEAM FIRE ENGINES AT THE COLOGNE EXHIBITION.

We referred last week in a short paragraph to the competitive trials of steam fire engines at the Cologne International Exhibition, 1865, and noticed the award of the various prizes. Our statement would lead to the impression that the first prize of 500 thalers was awarded to Messrs. Merryweather and Sons, conditionally, for the steam fire engine best suited for Cologne. We learn however, that the expression "an engine best suited for the city of Cologne" is an error, such expression having never been used by the Committee or Jury of the Cologne Exhibition, but that the prize has been awarded to Messrs. Merryweather unconditionally, for the best engine produced. With the prize of 500 thalers, which was placed in the hands of the Exhibition Committee by the Colonial Insurance Company, to be given for the best steam fire engine, Messrs. Merryweather also received a diploma from the Exhibition Committee certifying that the prize awarded to them was "the first prize for the best steam fire engine." The jurors' report of the trials having been since published, we now append a copy:—Official Report concerning the decision of the Jury at the trial of steam fire engines held at Cologne:—The undersigned, when judging of the steam fire engines, paid attention chiefly to the following points:—1. The time required for getting sufficient steam to work the engines. 2. The quantity of water in general, and especially its density in proportion to the distance over which the water was thrown. 3. The height of the stream. 4. The general construction of the engines, and especially their durability and

steadiness while being worked. 5. Their weight, from which to draw conclusions as to their transportability.

As regards the getting up of steam for working, the engine of Messrs. Merryweather and Sons, of London, effected this in 7 min. 28 sec.; that of Messrs. Shand, Mason, and Co., of London, in 11 min. 28 sec.; and that of Messrs. Wirth and Co., of Frankfort-on-the-Maine, in 16½ min. At a distance of 40 ft. the largest quantity of water was thrown by the engine of Messrs. Shand, Mason, and Co.; the second in this respect was that of Messrs. Wirth and Co., whilst as regards the compactness of the stream the latter decidedly took the first place, and Messrs. Shand, Mason and Co. were second in this respect. At a distance of 60 ft. Messrs. Wirth and Co. took the first place, and Messrs. Merryweather and Sons, the second place. As, however, the dimensions and working power of the engines are taken into consideration, then Messrs. Merryweather and Sons are fairly entitled to the first place. It should also be mentioned that the engine of Messrs. Wirth and Co. was worked during a wind more favourable than that under which the other two had to stand the trial.

Concerning the heights of the streams, the engine of Messrs. Wirth and Co. was first, even if full consideration is given to the unfavourable wind which the other two engines had to work against. All practical questions with respect to the construction of steam fire-engines have not yet been decided; all three engines are of solid workmanship, and during the time of working, as regards steadiness and safety fully guaranteed that they possessed every advantage that could be wished for. The weights of the engines are as follows, viz.:—Messrs. Merryweather and Sons, 3,813 lbs.; Shand, Mason, and Co., 6,128 lbs.; Wirth and Co., 5,833 lbs. Considering the short space of time in which Messrs. Merryweather and Sons' engines commenced working after the time of lighting the fire, and considering the proportionately equal results in other respects, and further in consideration of the remarkably light weight of this engine, the undersigned declare that they award to the steam fire-engine of Messrs. Merryweather and Sons, of London (I stand, 247) a *certificat* (Ausgesetzte) money prize of 500 thalers; and a gold medal to the steam fire engine of Messrs. Shand, Mason, and Co., of London (I stand, 248) and a silver medal granted by the Ministry to the steam fire engine of Messrs. Wirth and Co., of Frankfort-on-the-Maine (I stand, 156).

Cologne, June 20, 1865.

(Signed) M. GOLDSTEIN, T. WORTITZ, RÜHLMANN.

Messrs. Merryweather's engine was one of their ordinary make, part of an order being executed by them for the Spanish Government; it had a single steam cylinder and single horizontal double-acting pump, direct-acting and with a stroke of 18 in. The engine of Messrs. Shand, Mason, and Co., had a vertical steam cylinder and pump. That exhibited by Messrs. Wirth and Co. was the "Victoria," manufactured by the Amoskeag Company, in the United States, the same engine which competed in the large class at the Crystal Palace, in 1863. A German steam fire engine also competed, made by Messrs. Moltrecht and Co., of Hamburg: it weighed 3,467 lbs., its boiler and steam valve arrangements were almost an exact but an imperfect copy of the same in Merryweather's steam fire engine "Torrent," and the suction and delivery air vessels are laid horizontally, so as to form a bed for the engine and pumps, as used in the "old style" of Amoskeag engines. The performance of this engine was weak; its jet did not reach the water target, so that it is omitted in the official report of the Jury.

The maximum steam pressure used in each of the engine was 120 lbs. to the square inch. Messrs. Merryweather started with 100 lbs., Messrs. Shand and Mason with 60 lbs., and Messrs. Wirth and Co. with 60 lbs. steam pressure. In the first trial the water target was at a distance of 50 ft. vertical and 40 ft. horizontal from the mouth of the jet pipe, and in the second trial at a distance of 50 ft. vertical and 60 ft. horizontal, a large conducting pipe reached from the water target into a tank beneath, which contained 2,470 gallons. The jurors were Herr Wortitz, engineer, of Vienna, Dr. Rühlmann Professor, of Hanover, Dr. Goldstein, General, Director, from Beyenthal, Dr. Hartsteinn, Government Counsellor, and Director of the Agricultural Exhibition at Poppelsdorf, and Herr Perrelle, engineer, of Berlin.

CHARGES FOR SCIENTIFIC WITNESSES.

ON Monday last a trial of some importance to engineers and architects took place in the Court of Queen's Bench. It related to the charges to which a professional man was entitled when called on to give evidence in a court of law. Some time since a trial on a patent case took place, in which the late Mr. Richard Roberts was consulted as a scientific witness. Though he was not actually examined in court, he was present five days waiting to be called on if necessary. The suit, which was decided on Monday last, was instituted for the recovery of costs, and resisted on the part of the defendants because it was excessive. The amount claimed was £124. The sum paid into court was £50. The jury gave a verdict for £68 6s. The original demand was therefore excessive, and, knowing what we do of the late Mr. Roberts' character, we believe that had he been alive he would not have been a party to the unjust demand which was made in his name. Take, for instance, the first item in the bill of charges, "To receiving instructions in the case, and reading of specifications and other documents relating thereto, £15 15s." Take another item, "To letter from Mr. Wickens enclosing copy of the Lord Chancellor's opinion in the above case, and reading same, £10 10s." Every honest man must say that such charges were not only excessive but absurd, and we think that a slight has been cast on the bright reputation of Mr. Roberts by such demands being made in his name by his "surviving partner." The jury easily cut away £60 from the unreasonable demand. We were glad to see the reasonable rebuke which the judge administered to engineers and scientific men who are ever ready to be "employed as professional witnesses." Well might the judge say—"It would be well if there were a distinction between advising and assisting in a case, and giving evidence in it. Perhaps it was the mixing up of the two characters—of advocate or adviser and of witness—which tends to make what is called 'scientific evidence' so much open to animadversion. The gentleman who is consulted is intended to be, and afterwards becomes, a witness in the case, and all his professional interest and personal bias are enlisted on the side of the party by whom he is called or 'employed.'"

THE ELECTRICAL TORPEDO.

WE have recently had occasion to refer to the experiments which have been carried out at Toulon with this subtle agent; others have since been instituted on a much larger scale, and with extraordinary results. Hitherto the torpedo has not been properly appreciated as a defence in war; but it is now an established fact that it is as available for defence as ironclads and rifled guns are for attack. Mr. Nathaniel J. Holmes, however, and the scientific gentlemen associated with him, have recently made such progress in this new department of military engineering, that hereafter, in all plans for coast, harbour, and river defences, and in all works for the protection of cities, whether against attack by armies on land or by ships afloat, the electrical torpedo will probably play a most important part. The latest experiment made by the French Government at Toulon, affords some idea of the amount of destructive power which lies stored up within the electrical torpedo. With a charge of little more than 100 lbs. of gunpowder, a vessel 150 ft. long, and upwards of 40 ft. broad was instantaneously destroyed whilst floating in deep water in apparent security. At the word of command, given by Admiral Chabannes, a dull crashing sound filled the air, and the devoted craft was effaced from the surface of the water. The portions of the vessel examined afterwards all bore testimony to the tremendous effects of the concussion, even with a water depth of 16 ft. clear between the ship's bottom and the top of the sunken torpedo, and with a charge of only 100 lbs. of powder. Striking as was the result of the experiment performed by Admiral Chabannes, it is said to have been but a rough indication of the power embodied in the new engine of defence. The French Government have signified their intention to repeat the experiment, and to add to it another in which a ship will be annihilated under full sail. Meanwhile Mr. N. J. Holmes affirms that he has not revealed the secrets discovered by him with respect to the practical employment of the torpedo in warfare. The result of this experiment

plainly indicates what may be expected to accrue to even an ironclad, if sailing within range of one of these formidable engines of multiplied power.

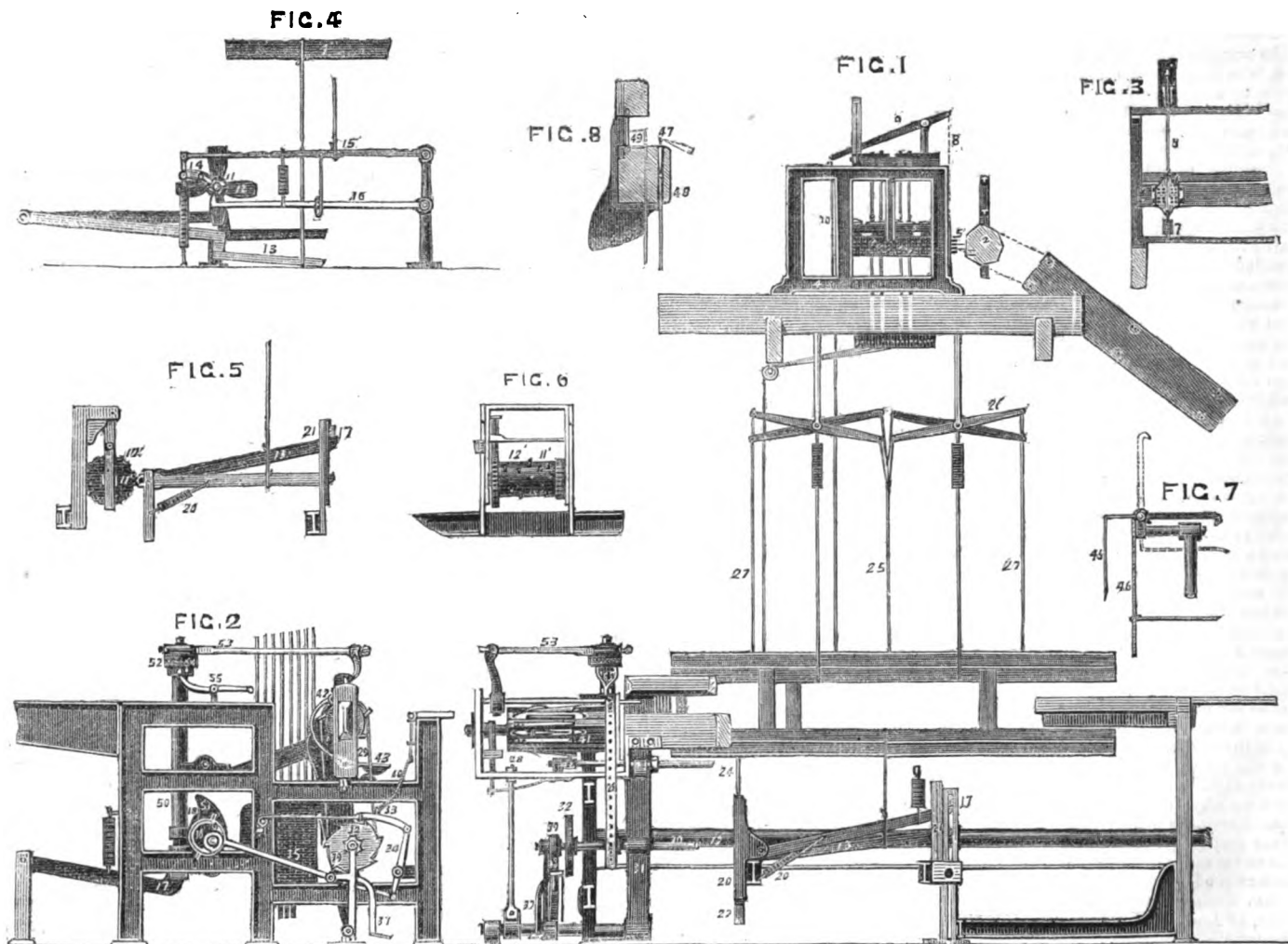
IMPROVED LOOMS FOR WEAVING.

LETTERS PATENT have been granted to Messrs. David Speirs, Alexander Boyd, John Aitken, and Matthew Gilmour, of Paisley, for an invention which comprises improvements in looms for weaving, the improvements being designed more particularly to promote the weaving by power of figured fabrics of and similar to the "Paisley shawl" class, and being in connection with some of the arrangements described in the specification of letters patent, dated 22nd February, 1862 (No. 472), and granted to James Kirkwood, and in the specification of letters patent, dated 29th August, 1863 (No. 2,138), and granted to David Speirs, Alexander Boyd, and James Kirkwood. By the present invention the heddle leaves 1, for producing the twill or twilled texture, are actuated by means of the main cylinder 2 and lift-board 3 of the jacquard apparatus 4, which acts on the figuring harness. The cylinder 2 has as many sides as there are cards in a "bride," and the number may be varied, but is commonly seven, as shown in fig. 1 of the accompanying engraving. The part of the cylinder 2 acting on what may be termed the heddle needles 5 has the proper holes for the purpose formed in its surface, thus dispensing with separate cards or plates, whilst, as in "twice drawing," a different action on the heddles is required when going over the bride of cards the second time; the front ends of the needles 5 are passed through a sliding plate 6, which is best seen in the detached face view, fig. 8, and by which the needles are shifted a little up or down, to make them face a higher or a lower part of the cylinder sides, which last are of course holed to suit the different actions required. The sliding plate 6 is drawn down by a spring 7, and is raised by a cord 8, lever 9, and cord 10; which last passes downwards to a lever actuated by or in connection with one of the heddle leaves. For depressing each of the heddle leaves 1 in succession, according to one modification, shown separately in fig. 4, there is a shaft 11, with a wiper or cam 12 on it for each heddle lever 13, and at the end of each run of shots this shaft is turned a part round by means of a lever and paul 14, acting on a ratchet wheel on it, and acted upon by the jacquard apparatus through a cord and lever 15, in connection with which lever there is a catch lever 16, to prevent the shaft from being turned too far round, and engaging with ratchets disposed reversely to those by means of which the shaft is turned. With these arrangements the proper heddle leaf is held down during the run of seven shots, whilst it is released by the turning of the cam shaft 11, to put down the next leaf, being then drawn up to the mid position by a spring 17, fig. 1.

Figs. 5 and 6 are views, at right angles to each other, showing an arrangement for effecting the same actions as that last hereinbefore described and somewhat varied therefrom, although embodying the same mechanical principles. In place of the cam shaft 11, there is a barrel 11', with pins 12' upon it, corresponding to the cams 12; but in place of the heddle levers 13 being depressed directly by the barrel 11', this shifts them, as required, into the position to be depressed by a lever 17, acted on by a cam 18 on the low shaft 19, fig. 2. It will be seen that with the pinned barrel arrangement a greater number of actions can be conveniently effected in one turn, whilst the force for actually depressing the heddle levers is derived directly from the low shaft 19, and is not transmitted through the jacquard apparatus and barrel. The heddle levers 13 are formed with elongated holes for the pin or spindle to pass through, on which they turn, and springs 20 are arranged to draw them towards the barrel 11', which is moved towards them by a spring being moved away from them by a bell-crank lever connected to the lever 17, and being turned a part round at the proper periods by means of ratchet wheel details acted on by the jacquard apparatus, and similar to those for turning the cam shaft 11, fig. 4. When a pin 12' on the barrel is opposite any lever 13, that lever is by it pushed over, so that its other end projects through the guide frame 21, and is caught and depressed by the lever 17, whilst the other levers 13 are kept back by their springs 20 and are not depressed.

A third modification of these parts is shown in

IMPROVED LOOMS FOR WEAVING.



figs. 1 and 2, but this differs from that shown in figs. 5 and 6 merely in there being substituted for the pinned barrel 11', a series of heavy cam-shaped pieces 22, which slide vertically in a casing 23, and are drawn up by cords 24 from the jacquard apparatus, whilst they descend by their own weight. When any one cam piece 22 is drawn up, it acts cam-wise or wedge-wise on the end of the corresponding heddle lever 13 and pushes it over so as to be caught and depressed by the lever 17. The heddle levers 13 are employed for raising as well as for depressing the heddles 1, those for depressing being connected directly to the bottoms of the heddles, whilst cords 25 from the others pass up to overhead reversing levers 26, the opposite ends of which are connected by cords 27 to the tops of the heddles, an arrangement which is well understood.

The arrangement for holding down the depressing levers 13, figs. 2 and 5, is similar to that described in the specification, No. 2,138, 1863, before referred to. When the arrangement shown in fig. 4 is employed, the depressing of a heddle leaf causes the button or knot on its wire or tail to be drawn down below the lift board 3 of the jacquard apparatus, but on the release of the leaf a spring applied to the upper end of the tail or wire draws the button or knot up again to the level to be caught by the lift board for being raised thereby at the proper time, so that on the lift board rising it can act on the button or knot through its entire stroke, which permits of the connecting of the tail or wire to the heddle leaf or lever with a more favourable leverage, and of the parts being better balanced and more easily worked than in the older arrangement, in which the heddles were depressed directly by the jacquard apparatus, and in which the lift board had to move through a large portion of its stroke before beginning to act on the heddle levers.

Rotating shuttle boxes 28 are employed, these shuttle boxes being both connected by pitch straps 29 to pulleys on a shaft 30, extending across the loom and mounted on the lower parts of the lathe swords 31. The details for working the shuttle boxes are by preference applied to the shaft 30 below, and consist in the example represented of a ratchet wheel 32, acted on by a

catch or pawl 33, jointed to a lever 34, which last is actuated by a rod 35 from an eccentric 36 on the low shaft 19. A foot lever 37 is provided whereby the attendant, when requiring to adjust the boxes by hand, can relieve the hammer 38, which is pressed upwards by a spring against a concave-faced wheel 39, to keep the shaft 30 steady between the shifts. The turning catch 33 can be relieved by a cord and button 40; or it might be connected to the foot lever 37, to be relieved by it. The shuttle boxes 28 may be arranged for picking either from the front side or from the top; when arranged for picking from the top, as shown in figs. 1 and 2, each shuttle cell is provided with a protector or swell lever 41, which is set in a cavity cut obliquely between the two cells, and so that its outside projects beyond the outer surface of the shuttle box in order to act on the protector lever 42, which last is curved round into a suitable position. The pressure of the protector lever 42 is taken off at the time of throwing the shuttle by the riding of the dog or catch 43 over a projection 44, whereby it is lifted up. There is a west fork at each side of the loom, and each fork 45, as shown on an enlarged scale in fig. 7, has attached to it a cord 46 in connection with the heddles, whereby it is turned completely down out of the way, as indicated by the dotted lines, when the shuttles are passing from its side and its action is not needed. To keep out of the way of the acting west fork all the west threads but the last one thrown, a jointed finger 47, shown in the enlarged section, fig. 8, is made to rise up through a hole in the race piece 48, in front of the line of the shuttle's motion, and at the beat up of the lathe this finger tumbles forward and presses the previously thrown wests down clear of the fork. In connection with the forks 45, arranged as hereinbefore described, and with the tumbling finger 47, or in connection with the improved fork 45 only, a lifting finger 49, fig. 8, may be arranged to lift the last west thrown, to be more certainly in the way of the fork, such finger 49, when not lifting, being in a groove cut across the race piece 48. When picking from the top of the shuttle box 28, as shown in figs. 1 and 2, the "top cone picking motion" may be used, but it is arranged so that the vertical shafts 50 are actuated on both

sides at every stroke, the low shaft 19 having both picking wipers 51 on the same side, and being driven at the same speed as the crank shaft. The upper part 52 of each shaft 50, carrying the picking stick or lever 53, is connected to the lower part by a clutch 54, having a hole into which there enters a short strong pin, projecting up from the top of the shaft 50, which last is made tubular to receive the spindle of the upper part. When either picking stick is not to pick it is lifted out of gear by a clutch lever 55, actuated from the jacquard apparatus or from the heddle movements as may be convenient.

BRIDGE OVER THE SCHELDT AT ANDENARDE.

THE application of the "bowstring" principle of bridge construction has been attempted in a somewhat peculiar manner by the Belgian engineers in the above bridge, of which we give a sheet of illustrations. It was erected on the railway called the Hainaut and Flanders line, and it crossed the Scheldt at Andenarde, at an angle with the axis of the river of 59 deg. 41 min. 25 sec.; the width required to give a free passage to the waters was about 63 ft. 6 in., and the extra width of the towing path was about 10 ft., measured normally to the opening, so that the clear span of the arch was made 91 ft. 2½ in. on the skew. The designer of this work was M. Auguste Dailot, Ingénieur ordinaire, acting under the orders of M. Léon Marsillon, Ingénieur en chef of the line.

The peculiarity of this bridge lies in the application of the arch, which are made in two pieces, and butt together freely, being maintained in their position by keys and wedges; and in the roadway, which is made of brickwork, carrying the ballast, which serves to diminish the noise made by the passing train. Necessarily, the weight of iron thus employed is very great, but we cannot conceive that this fact should alone account for the great excess of weight of this bridge over the ordinary form of girder generally employed. Thus, the weight that would be ordinarily given to the ironwork of a straight girder bridge would be about 12 cwt. per foot forward; in this case, however, the weight was

BRIDGE OVER THE SCHELDT AT AUDENARDE.

Fig. 1. ELEVATION.

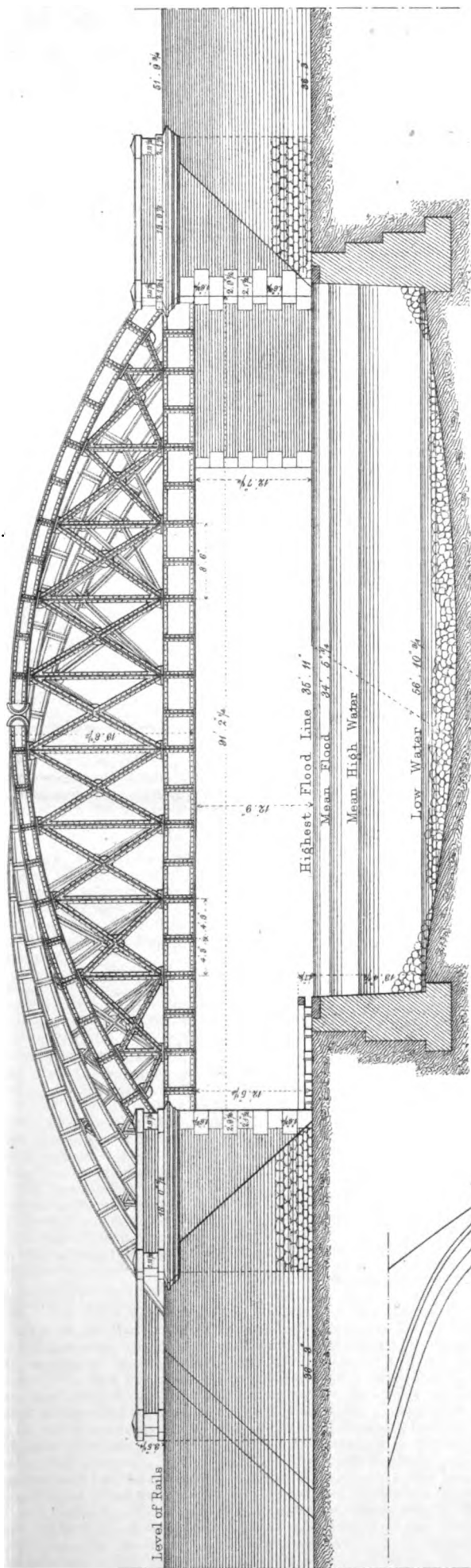
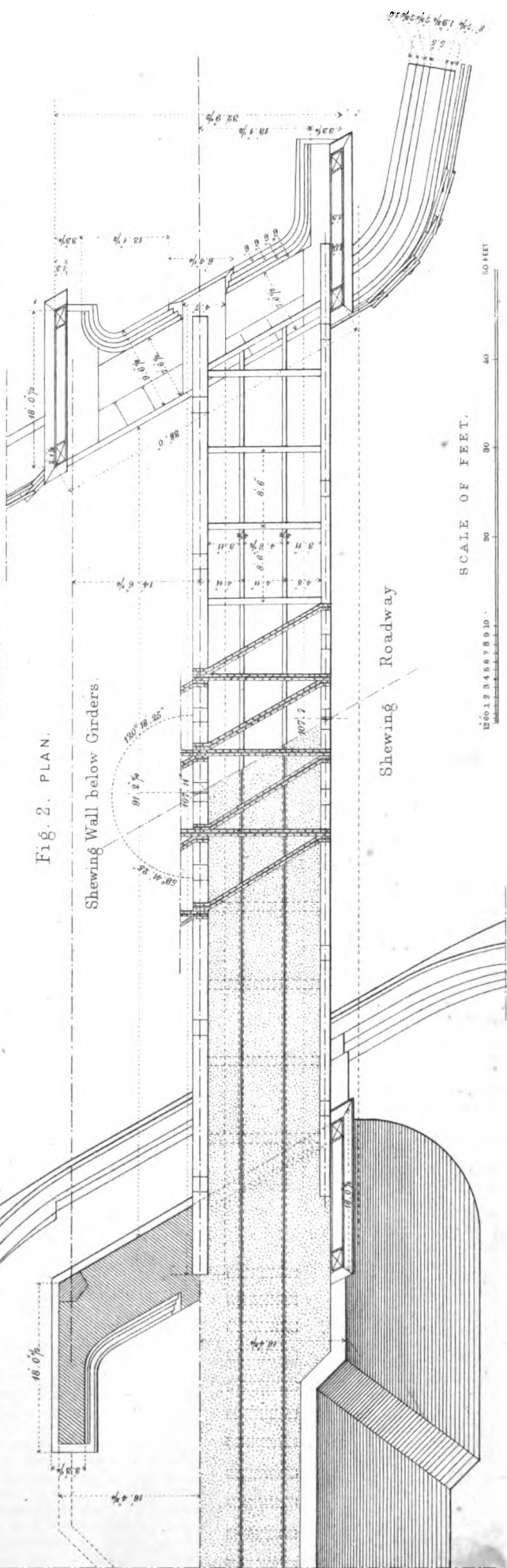


Fig. 2. PLAN.



at least 18 cwt. per foot, and the results of the trials showed that there was not too much strength in the arch.

There are three girders of the form represented in the engraving given, which are maintained in their position by the roadway at the bottom, and by a cross piece of + iron measuring 6 in. in the side at the top. The height of the assemblage is 19 ft. 8½ in., composed of the bottom girder of about 3 ft. high; the arc, which is of 14 in. thickness or depth at the junction, and the rise of the arc, which is about 15 ft. 6½ in. The pieces that thus form the bridge are spaced at the distances of 14 ft. 6 in. apart from centre to centre, and the distance between their inner borders is 13 ft. 2 in.; comprehending 5 ft. for the roadway, and two side spaces of 4 ft. 1 in. each.

MANCHESTER BOILER ASSOCIATION.

THE last ordinary monthly meeting of the Executive Committee of this Association was held at the offices, 41, Corporation-street, Manchester, on Tuesday, July 4th, 1865, when Mr. L. E. Fletcher, chief engineer, presented his report, of which the following is an abstract:—

During the last month 136 engines have been examined, and 273 boilers. Of the boiler examinations 160 have been external, 15 internal, and 98 thorough or entire. The following defects and omissions have been found in the boilers examined:—Furnaces out of shape, 4; fractures, 3; blistered plates, 8; internal corrosion, 3; external corrosion, 19; internal grooving, 5; external grooving, 2; feed apparatus out of order, 7; water gauges ditto, 19; blow-out apparatus ditto, 6; fusible plugs ditto, 5; safety valves ditto, 15; pressure gauges ditto 11; boilers without glass water gauges, 3; without blow-out apparatus, 7; without feed back-pressure valves, 4.

During the past Whit-week, when many of the works have been stopped, every endeavour has been made to examine internally and in the flues all the boilers of those members who made application. This has been done in every case with but two exceptions, and these have subsequently been arranged for. There are still, however, many of our members who might, with a little foresight, have their boilers "entirely" examined when at rest at these public holidays,—such as Whitsuntide, Christmas, Easter, &c.,—and the Association will gladly make arrangements to meet the extra demand for inspections at these times. It is imperatively necessary, however, that due notice should be given, so that arrangements may be made for meeting the demand.

Three explosions have occurred during the past month, from which two lives have been lost and sixteen persons injured. The following is a statement of explosions from May 27th, 1865, to June 23rd, 1865, inclusive:—No. 26 (May 30), particulars not yet fully ascertained, 5 persons injured; No. 27 (June 1), ordinary single-flue, or Cornish, internally fired, 2 persons killed, 7 persons injured; No. 28 (June 6), locomotive, 4 persons injured. No. 27 explosion, which was of a very disastrous character, two persons being killed, and seven others injured, occurred at a brewery, on June 1st, to a boiler not under the inspection of this Association. I made a personal investigation a day or two after the explosion had occurred, and found that it arose simply from collapse of the furnace flue, a subject to which this Association has called such constant attention in its reports.

REAPING MACHINES.

AN invention has been patented by Mr. W. Brenton, of Polbathick, Cornwall, which consists of an apparatus for delivering the corn cut from reaping machines. For this purpose a roller is mounted upon a shaft behind the finger bar and cutters; one end of this roller shaft revolves in a fixed bearing, the other end is carried by a lever which vibrates upon a fulcrum. Upon the outer end of this roller shaft there is a friction wheel, immediately opposite to but out of contact with a corresponding friction wheel on the large driving wheel of the machine. When a sufficient quantity of corn has been cut to form a sheaf, the attendant presses down the treadle of the vibrating lever with his foot, which brings the two friction wheels into contact, when the roller revolves and the sheaf is delivered from the machine. In the engraving fig. 1 is a side elevation, and fig. 2 a plan view of so much of a

REAPING MACHINES.

FIG. 2

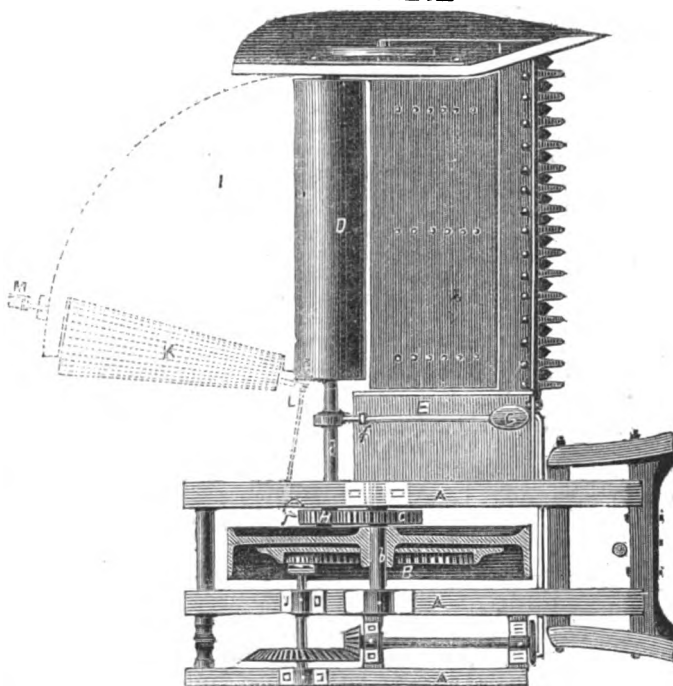
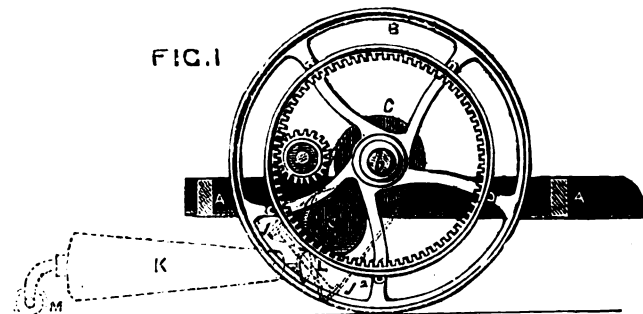


FIG. 1



reaping machine as is necessary to explain the nature and mode of performing the said invention. The same letters refer to similar parts in each of these drawings. A A is the framing of the machine; B the large travelling and driving wheel, the shaft of which b carries the friction wheel C; D is a roller on the shaft d, which revolves at one end in a fixed bearing, while the other end is supported by a bearing on the end of a vibrating lever E, which has a fulcrum at f, and is furnished at the other end with a treadle G. Upon the end of the shaft d there is a smaller friction wheel H, opposite to but out of contact with the corresponding friction wheel C. Whenever the attendant presses down the treadle G with his foot the other end of the lever and the shaft d is raised, and the friction wheel H is brought into contact with the wheel C, and the roller D is made to revolve. When a sufficient quantity of corn or grass has been cut to form a sheaf or cock, the attendant presses down the treadle, which causes the roller to revolve and deliver the cut corn from the machine. The roller D may be cylindrical or polygonal on its surface, which may be either plain or furnished with hooks or pegs. And in order to deliver the sheaf of cut corn at the side in preference to the end of the machine, a delivery board I and roller K are applied to the end of the machine by means of hooks or hinges. Motion is given to the roller K by a cord or belt from the friction wheel C, which passes round guides j' j' to the pulley L on the shaft of the roller K. M is a trailing wheel or castor to support the hinder part of the delivery board I.

INSTITUTION OF CIVIL ENGINEERS.

THE Council of the Institution of Civil Engineers have awarded the following Premiums for the past session:—1. A Telford medal, and a Telford premium, in books, to Joseph William Bazalgette, M. Inst. C.E., for his paper, "On the Metropolitan System of Drainage, and the Interception of the Sewage from the river Thames." 2. A Telford medal, and a Telford premium, in books, to Calcott Reilly, Assoc. Inst. C.E., for his paper "On Uniform Stress in Girder Work, illustrated by reference to two bridges recently built." 3. A Telford medal, and a Telford premium, in books, to Edward Hele Clark, for his "Description of the Great Grimsby (Royal) Docks, with a Detailed Account of the Enclosed Land, Entrance Locks, Dock Walls, &c." 4. A Telford Medal, and a Telford premium, in books, to Captain Henry Whatley Tyler, R.E., Assoc. Inst. C.E., for his paper "On the Festiniog Railway for Passengers; as a 2-foot gauge, with sharp curves, and worked by Locomotive Engines." 5. A Telford premium, in books, to John England, M. Inst. C.E., for his paper on "Giffard's Injector." 6. A Telford premium, in books, to Thomas Hawthorn, for his "Account of the Docks and Warehouses at Marseilles." 7. A Telford premium, in books, to Edward Fletcher, for his paper "On the Maintenance of Railway Rolling Stock." 8. A Telford premium, in books, to Edward Johnston, M. Inst. C.E., for his paper on "The Chey-Air Bridge, Madras Railway." 9. A Telford pre-

mium, in books, to Godfrey Oates Mann, M. Inst. C.E., for his paper "On the Decay of Materials in Tropical Climates, and the methods employed for arresting and preventing it." 10. A Telford premium in books, to William Jerry Walker Heath, Assoc. Inst. C.E., for his paper "On the Decay of Materials in Tropical Climates, and the methods employed for arresting and preventing it." 11. A Telford premium, in books, to Joseph Taylor, Assoc. Inst. C.E., for his paper on "The River Tees, and the Works upon it connected with the Navigation." 12. The Manby premium, in books, to Henry Burdett Hederstedt, Assoc. Inst. C.E., for his "Account of the Drainage of Paris."

COMPOSITION FOR PRESERVING SHIPS' BOTTOMS.

DR. HENRY DE BRIOU, of 35, Welbeck-street, Cavendish-square, has recently patented an invention which consists in coating the metals, iron, copper, zinc, the ships' sides and bottoms, and all surfaces or objects to be protected, with an improved composition formed of vulcanised india-rubber 750 parts, and mineral pitch 250 parts. The india-rubber cut into small pieces is thrown into a copper cauldron, placed upon a slow fire and heated until it is melted; all the time it must be stirred up, then the mineral pitch is added and melted; the mixture must be stirred up for some time until the two substances are thoroughly mixed together, and left boiling for two or three hours; then the fire is put out. Before it cools down, the composition is poured into barrels, copper, iron, or other vessels, and kept ready for use. To apply it, the requisite quantity, put into a copper vessel, is placed upon a slow fire, melted again, and spread over the surfaces to be protected by means of a vegetable brush; and then to spread it smoothly and uniformly upon the surfaces, a lighted torch of reeds, such as used in melting tar, is held close to it, which makes it run and gives it a smooth surface.

DATE OF THE ENGLISH CHANNEL.

BY JOSEPH PRESTWICH, ESQ., F.R.S.

At a recent meeting of the Geological Society a communication, of which the following is an abstract, was read. It contained additional observations on the raised beach of Sangatte, with reference to the date of the English Channel, and the presence of loess in the cliff-section. In his paper on the loess and quaternary beds of the north of France and south-east of England, Mr. Prestwich expressed an opinion that the break in the land between France and England was not the result of the last geological change, but that the channel existed at the period of the formation of the low-level gravels of the Somme and Thames Valleys, and probably at that of the high-level gravels. During a recent visit to the Sangatte raised beach, the author recognised fragments of chert in the shingle and associated sands, which he inferred were derived from the lower cretaceous strata; associated with them were fragments from the oolitic series of the Boulonnais and two pebbles of red granite, probably from the Cotentin. These facts seemed to the author to add much probability to the existence of a channel open to the westward, and extending between France and England, anterior to the low, and possibly to the high-level valley-gravel period. Above the raised beach occurs a mass of chalk and flint-rubble, with beds of loam, from 20 to 80 feet thick, and containing land-shells. Mr. Prestwich considered this accumulation analogous to the loess, which it resembles in general character, while the shells found in it belong to species common in that deposit.

MOTION IN A CIRCLE.

BY EDWARD SANG, ESQ.

A PAPER was lately read before the Royal Society of Edinburgh on the motion of a heavy body in the circumference of a circle, in which a new investigation is given. The computation of the time of descent in a circular arc is an essential part of the theory of the pendulum, concerning which it is stated in elementary works that the time of oscillation is nearly independent of the extent of the arc; the degree of nearness, however, being left unexplained. It is only when we come to the more profound treatises on theoretical mechanics that the methods of computing the true time of oscillation are described. In these works it is shown that the time of oscillation increases with the extent of the arc; the formula usually given for a simple pendulum being

$$T = \pi \sqrt{\frac{l}{g}} \left\{ 1 + \left(\frac{1}{2}\right)^2 \sin^2 \alpha + \left(\frac{1 \cdot 3}{2 \cdot 4}\right)^2 \sin^4 \alpha + \left(\frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6}\right)^2 \sin^6 \alpha + \text{etc.} \right\}$$

in which α is the fourth part of the entire angle through which the pendulum swings. This formula is obtained by expanding the binomial expression $\{1 - \sin^2 \alpha\}^{-\frac{1}{2}}$ in $d\alpha$, and integrating each term separately from $c=0$ to $c=90$ deg. These operations require familiarity with the higher branches of the integral calculus; and hence the theory is almost unknown to the great bulk of students of mechanics. Mr. Sang's investigation is very elementary, and leads to a computation much

vertically, N being the lowest and Z the highest point; and if we suppose a minute heavy body A to be projected along the circumference from the point N with the velocity which it would have acquired in falling from A to N; then as the body ascends along the circumference it loses velocity, so that when arrived at the point α its velocity is that which is due to a descent through the distance AG; and when the body has arrived at the zenith point Z its velocity is that which is due to a descent from A to Z. Thereafter it descends along the other semicircumference, acquiring velocity as it proceeds, and, friction and other resistances apart, it arrives at the point N with its initial velocity. In this case the motion is continuous but not uniform.

If, again, another heavy body be projected from N with a velocity due to a descent through the distance NB less than NZ, its velocity when at the point β is that which is due to a fall from B to H; and when the body has arrived at the point F on a level with B its velocity is extinguished and thereafter it descends again along the arc FN, arrives at N with its initial velocity, and rises as far on the other side. Thus its motion is oscillatory. In this way we see that there are two distinct cases of motion in a circle; the former corresponding to the motion of an unbalanced fly-wheel, the latter to that of a pendulum or bell. The first case has never, so far as we are aware, been subjected to investigation.

THEOREM I.

If the distance NB be made a third proportional to NA and NZ, the time of ascending from N to Z is to that of ascending from N to F in the ratio of NF to NZ.

For if we make the distances Na and N β in the ratio of NZ to NF, and complete the construction as in the figure, the squares of the velocities at α and β respectively are proportional to the distances AG and BH, that is, putting va and $v\beta$ to represent those velocities,

$$va^2 : v\beta^2 :: AG : BH :: NA - NG : NB - NH$$

or taking the rectangle under the terms of the second ratio and NZ

$$va^2 : v\beta^2 :: NA \cdot NZ - NG \cdot NZ : NB \cdot NZ - NH \cdot NZ$$

$$:: NE^2 - Na^2 : NF^2 - N\beta^2$$

But from the construction we have

$$NA : NE :: NE : NZ :: NZ : NF :: NF : NB$$

$$:: Na : N\beta$$

wherefore

$$NE^2 - Na^2 : NZ^2 :: NZ^2 - N\beta^2 : NF^2$$

$$NZ^2 : NF^2 - N\beta^2 :: NE^2 : NZ^2 - Na^2$$

so that

$$NE^2 - Na^2 : NF^2 - N\beta^2 :: NE^2 (NZ^2 - N\beta^2) : NF^2 (NZ^2 - Na^2)$$

$$:: NE^2 \cdot Z\beta^2 : NF^2 \cdot Za^2$$

and thus the ratio of the velocity at α to the velocity at β is given by the proportion

$$va : v\beta :: NE \cdot Z\beta : NF \cdot Za :: NZ \cdot Z\beta : NB \cdot Za$$

Take now an exceedingly small portion as $\alpha\alpha'$ of the arc αZ , and make $Na' : N\beta' :: NZ : NF$; then the triangles $\alpha\alpha'$ and $\beta\beta'$ may be regarded as having the minute hypotenuses $\alpha\alpha'$ and $\beta\beta'$ straight, and as having the angles $\alpha\alpha'$ and $\beta\beta'$ right; and also as being similar to NaZ and $N\beta Z$ respectively. Also $\alpha\alpha'$ may be regarded as the difference (or differential) between Na and Na' , $\beta\beta'$ as the difference between $N\beta$ and $N\beta'$, wherefore

$$\alpha\alpha' : \beta\beta' :: Na : N\beta$$

$$\alpha\alpha' : \alpha\alpha' :: NZ : Za$$

$$\beta\beta' : \beta\beta' :: Z\beta : NZ$$

and, compounding these ratios, we have

$$\alpha\alpha' : \beta\beta' :: Na \cdot Z\beta : N\beta \cdot Za :: NZ \cdot Z\beta : NF \cdot Za$$

The time occupied in passing over the minute distance $\alpha\alpha'$ is obtained by comparing the length with the velocity, and so of the time of describing the distance $\beta\beta'$; wherefore

$$\text{time in } \alpha\alpha' : \text{time in } \beta\beta' :: \frac{NZ \cdot Z\beta}{NZ \cdot Za} : \frac{NF \cdot Za}{NB \cdot Z\beta} :: NB : NF :: NF : NZ$$

It thus appears that the time in which the one body α describes the minute arc $\alpha\alpha'$ is to that in which the other body β describes $\beta\beta'$, in the constant ratio NF to NZ. Now if we suppose the semicircumference NZ to be divided into a multitude of minute portions, of which $\alpha\alpha'$ is one, while the arc NF is divided into as many portions by making the chord $N\beta$ always to Na in the ratio of NF to NZ, the time in which each portion of the semicircumference NZ is passed over will bear to that in which the corresponding portion of the arc NF is passed over the same constant ratio, and thus we conclude that the times along Na and $N\beta$, and also the times along NaZ and $N\beta Z$ are in the same ratio.

THEOREM II.

The time of oscillation in a minute arc is equal to that in which the whole circumference would be described by a body moving uniformly with the velocity acquired by falling through the diameter of the circle.

The time in which the semicircumference NZ is described with the variable velocity must necessarily be greater than if the body were to retain throughout the initial velocity which it had at N; and must be less than the time in which the semicircle would be described with a uniform velocity equal to that which the body actually has at Z. These two limits, between which the actual time along NZ is included, are to each other in the ratio subduplicate of AZ to AN, that is in the ratio of AN to AZ or of AE to AZ.

If one body were to describe NZ with the velocity due to a descent from A to N, and a second with a velocity due to a descent from Z to N, the time by the latter would be to the time by the former in the ratio subduplicate of NZ to NA, that is in the ratio of NF to NZ. Therefore the time of descent from N to F must be greater than the time in which the semicircumference NZ would be passed over with a uniform velocity due to a descent from Z to N. Again, since $AZ : ZB :: NA : NZ$, the velocity acquired in descending from A to Z is to that due to a descent along Z β in the same subduplicate ratio as before, viz., as NZ to NF; wherefore the time of describing the arc FN is less than that of describing the semicircumference with the velocity due to a fall along Z β ; and thus we have two limits between which the time of oscillation is comprised.

If the arc FN were made small, the distance Z β would approach to the diameter ZN, and thus the two limits between which the time of oscillation is included would be brought close to each other, so that for an excessively small arc the time of oscillation, that is of ascending from N to F and thence descending again to N, must, almost exactly, be equal to that in which a body moving with a velocity uniformly equal to that due to a descent along ZN would describe the whole circumference.

If we put g for the intensity of gravitation, l for the radius of the circle (length of the pendulum), and B for the angle NZF, measured by half the arc NF, the velocity acquired in descending from Z to N is expressed by $2 \sqrt{g l}$, while that due to a fall through Z β is $2 \cos. B \cdot \sqrt{g l}$; wherefore the time of oscillation is between the limits

$$\frac{2 \pi l}{2 \sqrt{g l}} \text{ and } \frac{2 \pi l}{2 \cos. B \cdot \sqrt{g l}}$$

that is between

$$\pi \sqrt{\frac{l}{g}} \text{ and } \sec. B \cdot \pi \sqrt{\frac{l}{g}}$$

THEOREM III.

If the body A be supposed to be acted-on by gravitation, of which the intensity is proportional to NZ, while B is influenced by gravitation proportional to NA, the time of a revolution by A becomes equal to that of an oscillation by B.

Let us suppose that the gravitation which acts on the body A is proportional to NZ, while that which influences B is proportional to NA, or that

$$G^A = NZ \cdot NZ; G^B = NZ \cdot NA$$

then the velocities acquired in descending through equal distances, being in the subduplicate ratio of the intensities of gravitation, must be proportional to NZ and NE; but, when the intensities of gravitation are alike, the time of revolution by A is to that of oscillation by B, in the same ratio NZ to NE; wherefore with these dissimilar intensities of gravitation the times must be alike.

We shall call these two motions conjugate to each other.

If we suppose (fig. 2) that the two bodies A and B set off at the same instant from the point N, and both in one direction; A, acted on by gravitation $G^A = NZ \cdot NA$, and having an initial velocity due to a descent from A, while B, influenced by gravitation $G^B = NZ \cdot NB$ sets out with a velocity due to the height BN, then, if Na be made to N β in the ratio NZ : NE, the two bodies will reach α and β simultaneously; and when A reaches the highest point Z, B reaches its highest point F. After that A descends along the other semicircumference while B returns from F to N, meeting A there. Continuing their motions A ascends along the semicircumference NFZ, while B rises from N to L. Thereafter A descends along ZLN and overtakes B at the nadir point N. These phases, friction and all resistances apart, will now be repeated. Here it is to be observed that while the oscillating body B makes one complete oscillation, that is, while it proceeds from N to F, thence back to N, up to L, and down again to N, so as to have the same velocity in the same direction as at first; the revolving body A has made two complete revolutions.

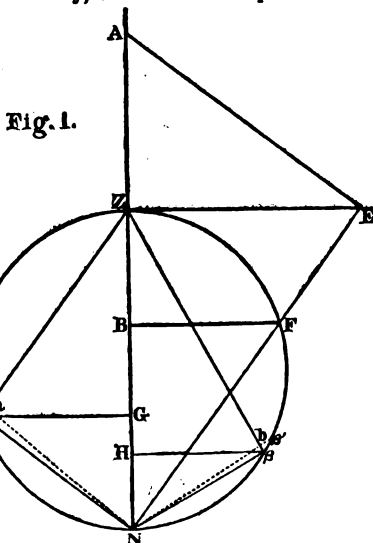
(To be continued.)

Correspondence.

BREECH-LOADING ORDNANCE.

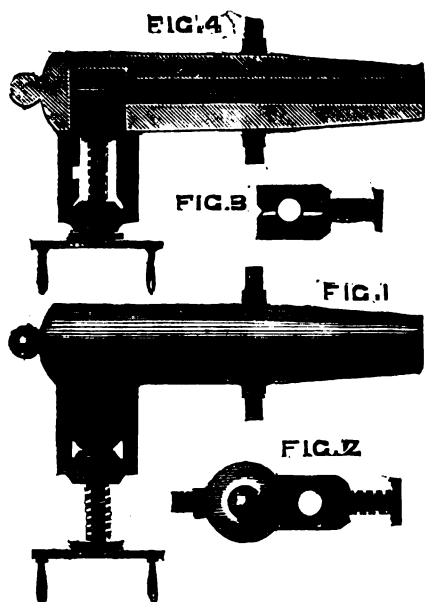
TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Observing the interest you take in the progress of breech-loading ordnance, I beg to forward you a sketch for a new breech-loading gun, the ad-



more concise than any previously known. We propose to give an account of it in a few short papers. If NZ, fig. 1, be the diameter of a circle placed

vantages of which are, greater strength in breech and less strain upon the screw during firing. It will also be perceived that the breech-piece is not so liable to be blown out as in the Armstrong gun. With reference to the sketch, fig. 1 is a gun showing



breech with breech-piece drawn ready for inserting shot; fig. 2, end of gun showing breech for shot; fig. 3, square breech showing groove, screw, &c.; fig. 4, section of gun showing breech screwed home ready for firing.

Yours, &c.,
BOLTON, June 30. BREECH-LOADER.

TO CORRESPONDENTS.

The *MECHANICS' MAGAZINE* is sent post-free to subscribers of £1 ls. 8d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. R. A. Brooman, of 166, Fleet-street, E.C.

Advertisements are inserted in the *MECHANICS' MAGAZINE* at the rate of 6d. per line, or 5d. per line for 6 insertions, 4d. per line for 13 insertions, 4d. for 26 insertions; and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editors, 166, Fleet-street.

To insure insertion in the following number, advertisements should reach the office not later than 5 o'clock on Thursday evening.

We must absolutely decline attending to communications unaccompanied by the name and address of the writer, not necessarily for insertion, but as a proof of good faith.—Ed. M. M.

RECEIVED.—W. H. H.—R. P. E.—R. C. E.—F. M.—W. and G.—J. W.—C. P.—W. W.—Com. S.—M. H. S.—W. R. E.—S. and S.—J. W. W.—M. S.—F. W.—C. P. D.

Miscellaneous.

At the annual general meeting of the Society of Arts, held on the 28th ult., the following members were elected to fill the several offices:—President: H. R. H. the Prince of Wales, K.G. Vice-Presidents: Sir Wm. G. Armstrong, Thomas Baring, M.P., Lord Berners, W. H. Bodkin, Sir J. P. Boileau, Bart., The Earl of Caithness, Harry Chester, Henry Cole, C.B., The Earl Granville, K.G., F.R.S., Edward Hamilton, William Hawes, C. Wren Hockyns, Lord Henry Lennox, M.P., Lord Lyttelton, Right Hon. Sir John S. Pakington, Bart., M.P., Sir Thomas Phillips, F.G.S., The Marquis of Salisbury, K.G., The Duke of Sutherland, Thomas Twining, Vice-Chancellor Sir William Page Wood, F.R.S. Council: Professor Bentley, D. Robertson Blaine, Stephen Cave, M.P., John Bailey Denton, Peter Graham, Henry Maudslay, Samuel Redgrave, Rev. W. Rogers, Sir Francis Sandford, Col. Scott, R.E., Geo. F. Wilson, F.R.S., Thomas Winkworth. Treasurers: W. B. Simpson, Seymour Teulon. Auditors: H. Reader Lack, Philip Wright. Secretary: Peter Le Neve Foster, M.A. Financial Officer: Samuel Thomas Davenport.

The Council of the Society of Arts have awarded the Gold Albert Medal, founded as a memorial of his Royal Highness the late president of the society, to his Imperial Majesty the Emperor of the French, for distinguished merit in promoting in many ways by his personal exertions, the international progress of arts, manufactures, and commerce, the proofs of which are afforded by his judicious patronage of art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects.

Among the many articles in japanned ware made very extensively at Bilston, in Staffordshire, is the coal vase. These are made of thin sheet iron, stamped out into the required form, and put together with great rapidity. A novel feature of the drawing-room vase is the addition of wheels, in connection with which a still greater improvement will shortly be introduced to the public by an enterprising maker there.

In America there are some lines of railroad which run side by side, and of which the Morris and Essex and the New Jersey Transportation Company are examples. Trains on these roads start at the same hour and for three or four miles run side by side so close that passengers are said to reach out of the windows and shake hands with each other when running 25 miles an hour.

Messrs. Crose and Blackwell have lately had a large boiler made of aluminium, in which their jams and preserves are boiled. By this means all injury from any contact with copper is avoided, and the aluminium is not attacked by the operation.

An American exchange states that a huge raft of logs, estimated to contain 700,000 ft. of lumber and measuring half a mile in circumference, was towed up Lake Memphremagog a short while since. It belonged to a company in Newport whose steam mill sawed 13,000 ft. of lumber in nine hours and forty minutes.

It is stated that Messrs. Palmer Brothers' immense iron and shipbuilding establishment at Jarro, on the Tyne, has passed into the hands of a limited liability company, with a capital of £2,000,000. The shares are said to be £5,000 each, and have all been taken up without having come into the market.

We understand that Mr. E. S. Allin, master armourer at Springfield, has invented a new breech-loading musket, which is highly commended. General Dyer, chief of the ordnance department at Washington, has ordered 5,000 muskets of the old model to be changed to breech-loading after Mr. Allin's plan.

Marshal McMahon has received one of the two gold medals bestowed by the Prussian Government on the successful exhibitors and patrons of the "Exhibition" of Cologne, as being "a great encourager of agriculture" in Algeria.

The new high-level line from Victoria to the centre transept of the Crystal Palace, has been visited by the Government inspector, and it is expected will be opened in a few days. With increased railway facilities and convenience, increased prosperity may be looked for at the Crystal Palace.

Nuremberg manufactures, besides glass beads, considerable quantities of amber beads. In Gablontz, in Bohemia, more than six thousand persons are engaged in the manufacture of beads that are made of pure glass, or of a composition. From the glass-houses, which are very numerous in Bohemia, the rods of different sizes are delivered to the glass mills for cutting, which is performed by water power or by hand. In 1828 there were in that neighbourhood one hundred and fifty-two mills in operation; a number of glass-blowers were likewise engaged, who possessed great dexterity in blowing the small beads with the assistance of a small blow-table.

The Buffalo (N.Y.) papers give an account of the trial trip of the first locomotive ever made in that place. It was made at Bell's Steam Engine Works, and has been sold, with another now in construction of the same class, to the Erie and Pittsburgh Railway Company, for 25,000 dols. each. On the trial on the Lake Shore-road the "David Bell" took three cars to Dunkirk with 150 passengers and worked with perfect success. On the return trip the engine ran 42 miles, including two stops, in 1 hour and 35 minutes, the last 10 miles being done in 13 minutes. The "David Bell" has cylinders 16 in. by 24 in.; driving wheels, 5 ft. 1½ in.; has 150 two-inch copper flues, and is arranged to burn either wood or coal. The weight of the engine and tender is 40 tons.

The annual *conversazione* of the Royal Institute of British Architects was held last Friday evening at their Rooms, Conduit-street, Hanover-square, at the invitation of the President, Mr. A. J. B. Beresford Hope, and the Council. Numerous interesting objects and works of art were exhibited; among them were a selection from the magnificent series of coloured drawings, copies of ancient stained glass by the late Mr. Charles Winston, lent for the occasion by the South Kensington Museum, and a number of architectural drawings by Mr. Teulon and other gentlemen, intended for the art exhibition at Alton Towers. In addition, the galleries of the Architectural and Photographic Exhibitions were thrown open. Among the visitors present not members of the Institute were: Lord Houghton, Sir Edward Cust, the Hon. Wilbraham Egerton, Mr. J. G. Hubbard, M.P., Mr. J. E. Gray, F.R.S., Mr. Manockjee Cursetjee, Professor Hughes, Dr. Salvati, Professor A. Mariette, Professor James Tennant, Dr. Hewitt, Captain Shaw, Dr. Sibson, Mr. T. Page, C.E.

At a meeting of the Brassmasters' Association, held on Thursday week at Birmingham, it was resolved, "That rolled brass, brass wire, and tubing be reduced 4d. per lb. and copper goods 4d. per lb.; also, that brass pin wire be reduced £2 per ton."

The new iron screw steamship "El Rahmanich" has just arrived in the Victoria Docks from Hartlepool. She was built by Messrs. Richardson, Duck, and Co., at Stockton-on-Tees, and fitted out for his Highness the Viceroy of Egypt, under the superintendence of the Peninsular and Oriental Company. Her extreme length is 234 ft.; beam, 34 ft.; depth to spar deck, 26 ft.; tonnage, old measurement, 1,524; gross, new measurement, 1,638. She has accommodation for 40 first and 30 second class passengers. Her engines are direct-acting surface condensing, of 300 horse-power, built by Messrs. J. Richardson and Sons, of Hartlepool. During her run from Hartlepool to Gravesend, with a boiler pressure of 25 lbs., and an indicated power of 1,200 horse, she maintained an average speed of 11½ knots, the engines never having been slowed during the whole distance. Her mean draught was 16 ft., and displacement 2,445 tons.

Mr. Henry Weiss, the delegate appointed by the Birmingham Chamber of Commerce, to attend the International Commission at Vienna, observes in his report that iron goods are taxed so enormously high that it seems probable that the attention of the Austrian Custom House authorities has not been called to the low value of the goods in proportion to their weight. Under the present tariff, waggon axles pay 63 per cent., axes 53 per cent., and bellows 89 per cent. on their cost price. The classification is also very imperfect, common iron chisels paying, for instance, 100 per cent., while the duty upon cast steel finer polished ones is only 25 per cent. These great contradictions, no doubt, owe their origin to the fact that, when a tariff was first framed, it remained for a considerable time, while the manufacturers in their rapid progress, changed not only the relations of the articles to each other, but also very much diminished the cost of production by the introduction of improved methods of manufacture.

By a return which has been issued from the Royal Mint, some interesting particulars are given relative to the coinage of the realm. In 1864 sovereigns and half-sovereigns to the amount of £9,535,597 were coined, and since 1855, £59,042,518. Last year the silver pieces coined represented a value of £535,194, the market value of the uncoined metal itself being only £521,003 5s. Amongst these coins were 579,670 silver three-halfpenny pieces, 79,200 silver pennies, and 47,520 silver twopenny pieces. No crown or half-crown pieces were coined. The silver coinage issued since 1855 represented a value of £3,397,000 18s. 4d., while the actual cost of the metal used was £3,334,663 8s. 7d. As a set-off to this profit, however, the Mint authorities lost in the same period of years £122,363 1s. 5d. by the re-coinage of worn silver coin. In 1864 copper coins representing £18,069 6s. 8d. were turned out, the actual value of the copper being no more than £9,660. From 1855 to 1864 inclusive the represented value of the copper coined was £915,268, the market value of the metal being £444,010 10s. 6d. In that period 913,920 half farthings were coined.

The East India Railway is rapidly approaching completion, while the income is increasing and the expenses diminishing. The whole of the line from Calcutta to Delhi is constructed, and in a short time traffic will be conveyed to and from those places—a distance of 1,100 miles—by an unbroken route. Within a couple of years from the present time the Company will be able to exchange traffic with the Great Indian Peninsula Railway Company, and there will then be an uninterrupted chain of railway communication from Calcutta to Bombay.

The "Great Eastern" has in her as nearly as possible 7,000 tons of cable, or, including the iron tanks which contain it and the water in which it is sunk, about 9,000 tons in all. In addition to this she has already 7,000 tons of coal on board, and 1,500 tons more are being taken in. When the rest of the coals and special stores are put aboard, they will bring her mean draught down to 32½ ft. Her total weight, including engines, will then be rather over 21,000 tons; a stupendous mass for any ship to carry, but well within the capacity of the "Great Eastern," of which the measurement tonnage is 24,000.

We are informed that several gentlemen who have recently returned from America—where they have been watching the movements on board the Monitors for foreign governments—have inspected the system of working ships' guns in fixed turrets, as arranged by Mr. Walker, of Cowper-street, City-road; and that they have expressed a favourable opinion thereon. Now that the Commission on turret ships has decided against movable turrets and recommended fixed ones, it is probable that Mr. Cowper's plan will be taken into consideration by the Government.

The question of thief-proof safes is about to be discussed in legal quarters. We understand an action has been commenced by Mr. Walker, of Cornhill—upon whose premises a memorable burglary was not long since committed—against Messrs. Milner, the safe manufacturers, upon the warranty given with the safe; heavy damages are, of course, being laid.

We learn that at the ironworks of Holmberg and Co., at Lund, a new invention has been applied by which tubes of iron can be cast by centrifugal force. The machine is of very simple construction; it is composed of a cylinder, which can be opened and closed, and into which molten metal is poured. A rapid rotary motion being imparted to the cylinder, the liquid mass is pressed against the sides, and the result is the formation of a perfectly uniform and straight tube. The machine was invented by a young workman named Auguste Larson, and the first trials proved completely successful.

Oil City is fast becoming famous for the energy and spirit of its citizens. A horse railroad between that city and Plummer is now in process of construction, and will be finished at an early day. One hundred cars and an equal number of trains have been ordered, and ere long wading in the mud will be remembered among things of the past.

The day appointed for the meeting of the National Artillery Association for competitive practice with big guns at Shueburyness is the 29th inst., and is looked for with great interest. Camp accommodation will be provided by the Government, and the camp will be under the command of a field-officer of Royal Artillery.

A very important circular affecting the interests of the public has been issued by the United Kingdom Electric Telegraph Company. It announces that the uniform shilling rate not having proved remunerative, it has become necessary to increase the charge. The company was established in November, 1860, and the shareholders patiently remained without any dividend for upwards of four years, in order to give the shilling rate a trial, and afford it ample time for its development. The maximum tariff is now fixed at 2s. for all England, Wales, and Scotland. The terms are to be, for 100 miles and under, 1s.; 200 miles and under, 1s. 6d.; and over 200 miles, 2s.; thus securing Lancashire and Yorkshire an eighteenpenny telegraphic communication with London and Glasgow, and other important districts.

From New South Wales we learn that a large timber mill has lately been established on the Goulburn river, and is capable of turning out 18,000 superficial feet of timber per week upon ordinary occasions, but, if pressed, can turn out 25,000 ft. The proprietors have erected a wooden bridge across the Goulburn river, which spans it 250 ft. from bank to bank, by a width of 15 ft., with a roadway of 12 ft.

Patents for Inventions.

ABRIDGED SPECIFICATIONS OF PATENTS.

THE Abridged Specifications of Patents given below are classified, according to the subjects to which the respective inventions refer, in the following Table. By the system of classification adopted, the numerical and chronological order of the specifications is preserved, and combined with all the advantages of a division into classes. It should be understood that these abridgements are prepared exclusively for this Magazine from official copies supplied by the Government, and are therefore the property of the Proprietors of this Magazine. Other papers are hereby warned not to produce them without an acknowledgment:—

BOILERS AND FURNACES,—3146
BUILDINGS AND BUILDING MATERIALS,—3146
CHEMISTRY AND PHOTOGRAPHY,—None
CULTIVATION OF THE SOIL, including agricultural implements and machines,—3141
ELECTRICAL APPARATUS,—None
FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.—3151, 3154, 3157, 3162, 3163
FOOD AND BEVERAGES, including apparatus for preparing food for men and animals,—None
FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.—3158, 3167
GENERAL MACHINERY,—3142, 3144, 3153
LIGHTING, HEATING, AND VENTILATING,—None
METALS, including apparatus for their manufacture,—3164
MISCELLANEOUS—3160, 3161
ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.—3138, 3156, 3166
SHIPS AND BOATS, including their fittings,—3142, 3147, 3150, 3154
STEAM ENGINES, &c.—3139, 3140, 3152
WAPFARS,—3144, 3149, 3159, 3165

3138 W. HOWES and W. BUNLEY. *Improvements in lamps for railway and other carriages, and in connecting lamps to carriages, a part of which improvements may also be applied to handles for carriages.* Dated December 17, 1864.

These improvements in lamps for railway and other carriages consist in the following arrangement for fastening and unfastening the doors of the said lamps. In place of the ordinary lamp used for that purpose the patentees use a spring handle and catch. The spring handle is attached to the door of the lamp, and the catch to the lamp. On closing the door, the tongue of the spring handle engages with the

catch and securely fastens the door. When it is wished to unfasten the door, the handle is turned, when its tongue is disengaged from the catch, and the door is unfastened. The inventors connect the tongue of the spring handle to the axis of the said handle by means of a screw in a manner similar to that by which the inside handles of carriages are connected to their spindles, and they cover the head of the screw by means of a cap which screws on the end of the axis, and protects and conceals the screw by which the tongue is fixed to the axis of the handle. The said screw cap may also be applied to the inside handle of carriages for the purpose of protecting and concealing the screw by which the handle is connected to its spindle. The improvements in connecting carriage lamps to carriages are as follow:—The free end of the arm by which the lamp is attached to the carriage they make somewhat in the form of a hook by turning up the extreme end of the said arm. In the side of the lamp they fix a recess or socket into which the hooked end of the arm fits, and in which it is fixed in the following manner:—To the lower side of the recess in which the end of the arm fits, a semi-tubular piece of brass or iron is fixed, its concave side being upwards, and on the upper side of the arm near its turned-up end a similar semi-tubular piece of brass or iron is fixed. When the lamp is placed on the arm so that the end of the latter engages in the recess of the former, the two semi-tubular pieces are presented to one another, so as to make a complete tube. The outsides of the semi-tubular pieces have a screw thread on them, and an annular screw cap placed upon the arm is capable of being screwed upon the screw thread on the semi-tubular pieces when they are brought opposite one another. The said pieces are thus bound firmly together, and the lamp securely fixed to the carriage. *Patent abandoned.*

3139 H. DAVEY. *Improvements in steam engines.* Dated December 17, 1864.

The first part of this invention relates to a particular arrangement of the valves of steam engines. The inventor makes the valve face of a circular form, with four openings (of a quadrant form), if for two cylinders, and with two only if for one; these openings radiate from the centre, and on this face is placed a circular valve with two openings, of a similar form to those in the face, one opening for the exhaust and the other for steam; this valve is caused to revolve with its centre coinciding with the centre of the said face by any convenient means, one revolution of the valve being produced in the same time as that of the crank shaft; the revolution of the valve causes the openings in it, which are placed diametrically opposite to each other, to pass alternately over the openings in the face, which are in communication with the respective steam passages of the cylinder or cylinders they are designed to supply, permitting induction and eduction at proper times. The second part of the invention consists in forming the condenser with a cold water cistern in the top, the bottom of which cistern is provided with holes to allow the water to descend into the condenser in the form of a shower, the said cold water cistern to be supplied with water by means of the air pump, which is to be made double-acting. The third part of the invention relates to slide valves, and consists in a particular arrangement, whereby the greater part of the back pressure of the steam is removed. The fourth part relates to the reversing gear of steam engines. The inventor extends the breadth of or bifurcates the eccentric rod at the point where it is connected with the pin of the rocking shaft, and forms a gab on each side, the eccentric rod facing in opposite directions and opposite to two studs or pins disposed on opposite sides of the rocking shaft or axis, into one of which pins the gabs take as may be required; when the engine is required to move in one direction, the rod by its gab is in connection with the pin on one side of the rocking axis, and when traversed that gab is removed and the opposite one placed in gear with the pin on the other side of the rocking axis. *Patent abandoned.*

3140 W. A. TURNER and T. T. COUGHIN. *Improvements in the means of and apparatus for obtaining motive power, and for the distribution and application thereof.* Dated December 17, 1864.

This invention consists of certain improvements in the mode of obtaining motive power by means of compressed air. The invention relates, first, to improved apparatus for obtaining air compressed to a much greater degree than has hitherto been accomplished by pumps used for the purpose, the result being that an increased power is obtained, and stored in a receiver or receivers of less dimensions than heretofore. The inventors propose to effect this object upon the principle of compressing air by a succession of pumps and receivers. In order to distribute the compressed air, and thereby convey motive power to engines in various localities, they propose to construct and lay down a main pipe or pipes from the principal receiver or store. At the entrance of the main in connection with the receiver they propose to apply a valve to regulate the pressure in the main junctions, provided with valves or stop cocks to convey or distribute and shut off, as may be required, the compressed air to engines in factories or buildings, or otherwise; and they propose to apply such power to engines by the intervention of a meter which shall indicate the quantity used, and the pressure, and shall be provided with a throttle valve which shall regulate the speed of the engine by aid of the governor, beyond which meter the compressed air is passed direct through the slide valves of the engine into the cylinder, thereby actuating the piston in the same manner as if steam were applied. *Patent abandoned.*

3141 J. A. HOPKINS and O. CUPLIN. *Improvements in ploughs and apparatus for tilling the soil.* Dated December 18, 1864.

This invention has for its objects the performance of the processes of ploughing and subsoiling in one operation. The subsoiling apparatus consists of one or more share or shares, points, prongs, or lines, secured by bolts or other convenient means to the body or frame of the plough in such a position as to penetrate the soil in the rear of the ordinary share. Such subsoiling apparatus is adjusted by screws, levers, or other suitable mechanical arrangement, so as to break up the subsoil to any required depth below the bottom of the furrow as made by the ordinary share. For adapting the invention to the various kinds of ploughs already in use, the inventors fit the said subsoiling apparatus to an adjusting clutch, which is readily attached to any plough by screws or other suitable fastenings. *Patent abandoned.*

3142 W. TATE. *Improvements in armour, and in making and applying the same for protecting wood and iron ships of war and batteries.* Dated December 19, 1864.

This invention consists in the use of and in improvements

in the manufacture and in the mode of applying iron and steel flat and round wire, galvanised and ungalvanised rope, stranded flat belts or sheets, or woven or plated sheets or belts of any kind of large and small size wires, woven wires in sheets, of round or flat wires applied singly in belts or sheets, of iron or steel wires, or intermixed as one belt or sheet, being (by preference) one-third steel and two-thirds iron wire, as armour for wood and iron ships of war and batteries, used singly or intermixed with sheets of millboard, leather, or compressed cotton, or in conjunction with wrought-iron or steel plates of any diameter. *Patent completed.*

3143 E. C. M. BERNARD. *An atmospheric machine, or the perpetual motion by atmospheric pressure.* Dated December 19, 1864.

This invention cannot be described without reference to the drawings. *Patent abandoned.*

3144 E. SWIVARSKI. *Improvements in breech-loading fire-arms.* Dated December 19, 1864.

This invention consists of improvements in opening and closing the breech ends of breech-loading fire-arms which have fixed barrels, and in which the cartridge is exploded by means of a horizontal needle, the said improvements being also applicable to muzzle-loading fire-arms. The inventor makes the breech end of the barrel, in which is placed the cartridge, externally of a conical form provided with three projections, and the other end of the breech piece is made in the shape of a female cone, so as to fit on the outside end of the barrel, and is also, like it, provided with three projections. The breech piece is provided with a lever or handle, by which it can be drawn back from the open end of the barrel when the gun is to be charged; and when it is desired to close the breech after charging the said lever is pushed forward and carries with it the breech piece the open end of which passes over the conical end of the barrel; the said lever, and consequently the breech piece, is then turned through about a sixth part of a circle, by which means the aforesaid projections in the open end of the breech piece are caused to pass behind the projections on the end of the barrel, thus holding firmly to it the breech piece. At the bottom of the breech piece is a small cylinder provided with two pointed pivots for tearing or piercing the cartridge, so as to prevent the concussion of the gases, produced by the explosion against the breech—that is to say, where the breech piece fits on to the barrel. *Patent abandoned.*

3145 C. W. ORFORD. *An apparatus for measuring water and other fluids at either high or low pressure.* Dated December 19, 1864.

The patentee claims, first, the use of a rolling weight as a motive power for turning the taps or cocks of water meters; second, the use of a piston or float moving freely upon the piston rod until such time as check d by tappets or other appliances thereto attached. *Patent completed.*

3146 Sir J. GRAY. *Improved taps or cocks for regulating the flow of water into, through, or from cisterns, pipes, and other receptacles or conduits.* Dated December 19, 1864.

In performing this invention the patentee constructs the taps or cocks with two valves, one the discharge valve, the other the inlet valve, which latter is also under certain conditions capable of acting as a check or stop valve for the purpose of shutting off the water from the discharge valve during examination or repair. Each of these valves is closed by the pressure of the water forcing the disc of the valve down upon its seat—an arrangement common to many valves now in use. The inlet valve may, by this invention, be converted into a check or stop valve by the mere act of removing the cover of the body of the tap or cock for the purpose of examining or repairing the discharge valve and its appurtenances. The invention cannot be described without reference to the drawings. *Patent completed.*

3147 H. F. M'KILLOR. *Improvements in compositions for coating or covering ships.* Dated December 19, 1864.

This composition is chiefly applicable for coating ships of iron. In making compositions for this purpose the patentee grinds together lime (by preference pure shell lime), sulphur, and protoxide of mercury, and mixes with these coarse brown sugar, and crude petroleum, or linseed or other suitable oil. The proportions in which he prefers to combine these materials are as follow:—1 cwt. of shell lime, 1 cwt. of sulphur, 14 lbs. of protoxide of mercury (or crude mercury may be employed), 1 cwt. of coarse brown sugar, 10 gallons of petroleum or other suitable oil, preferring 5 gallons of petroleum oil, and 5 gallons of melted tallow in place of all petroleum oil. The sulphur is first heated to about 240 degs. Fahrenheit, then the patentee adds the oil, and stirs it well in together with the sugar; the whole of the materials are then added and passed through a mixing mill. He prefers slightly to slake the lime before grinding it. The mixture thus produced will be of the consistency of a thin cement, and should be applied to the ship whilst hot. Or the mixture may be allowed to cool and be again heated before applying it to the ship. *Patent completed.*

3148 R. A. BROOMAN. *Improvements in furnaces.* (A communication.) Dated December 19, 1864.

These furnaces are arranged, as hereafter described, in such manner that the fuel is transformed into inflammable gases, to which the requisite amount of air is supplied necessary for their combustion. The objects of the arrangements are,—First, to divide the flame in rings or sheets to afford a great heating surface. Second, to surround this flame in hot air travelling at the same speed as the flame. Immediately under the boiler or vessel to be heated, and at the top of the furnace, the inventor places two metal or other refractory plates connected, but with a space between them proportioned to the quantity of air to be consumed. The lower plate is pierced with a number of holes proportioned to the quantity of heat to be developed. Each of the holes is supplied with a tube or burner, the flame from the fuel passes through these burners. The upper plate is pierced concentrically with the opening of each burner, with a hole five times larger than that opening, through which the air for the burning of the gas passes. The space between the plates forms a receiver for the air entering in proportion to the temperature and the draught regulated by dampers in the flue. The absorption of caloric, from the radiation and heating of the air, prevents the plates becoming red. The fire place is at the lower part of the furnace, and under the double plate or gas apparatus just described. Three openings, with doors, exist in the wall of the furnace below that apparatus, the uppermost for supplying the fuel, the next for the admission of air or steam, and the lowest for the extraction of scorias. The bottom plate, on which the fuel rests, is made to heat water in a tank or tube below it. The top of the upper plate should be concave to form a parabolic mirror, and its

surface polished to reflect the heat. Each burner may be fitted at top with a spiral or platinum ring, to prevent any portion of gas escaping without being burnt. Hollow ribs are formed on or in the lower plate for the passage through them of air to keep it cool. The working of the furnace will be readily understood; when the fire-place has been charged with fuel and that lighted, the gases produced, oxygenated by the air or by steam admitted through one of the apertures in the wall of the furnace, issue from the burners, where they come in contact with air or steam admitted through the apertures in the upper plate, and complete combustion, or as nearly as may be, takes place. *Patent abandoned.*

3149 Sir F. BLACKWOOD. *A new or improved apparatus for elevating or lifting shot or shell to the fighting deck of vessels or in batteries of war.* Dated December 19, 1864.

In carrying out this invention the inventor proposes to fix a foundation or bed plate in the lower part of the vessel on which two standards are set; these support, in bearings, a shaft, which carries a driving wheel having projections on its periphery for the purpose of actuating an endless chain for drawing a similar pulley-wheel set in bearings on the fighting deck at suitable distances apart; the endless chain is provided with arms or brackets for the purpose of supporting a series of metal receptacles or elevators, which are connected thereto by a hinge or pin joint set in projection at the bottom of each elevator; below the front or mouth of the elevators are protruding grooves or slots for the purpose of bearing on to upright guides extending to the fighting deck, and meeting in a semicircle at the base of the apparatus. The apparatus somewhat resembles the well-known dredging machine with lifting buckets. *Patent abandoned.*

3150 J. BUTCHART, H. STROUD, and S. A. MORRISON. *Improvements in reefing and stowing jib sails from the deck.* Dated December 19, 1864.

This invention consists in attaching a swivel block to the upper part of the jib stay, such block being connected to the mast by the jib halyards, and in applying at the lower part of the jib stay a whelped sheave with swivel attached to the hoop or hounds of the boom; on the boom, near or under the whelped sheave, are two leading blocks for the reefing claims to pass through and over the sheave; the ends of the reefing chains are attached to two blocks. Thus it will follow that, by hauling on the reefing chains, the whelped sheaves will be caused to revolve, and the stay will revolve and take up the sail, and *vice versa*. *Patent completed.*

3151 E. T. HUGHES. *Improvements in machinery or apparatus for making laces, braids, cordings, and edgings.* (A communication.) Dated December 19, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

3152 H. J. H. KING, H. E. SMITH, and J. B. HOWELL. *Improvements in the slide valves of steam engines and in apparatus connected with or operating the slide valves of steam engines.* Dated December 19, 1864.

This invention relates, first, to slide valves of steam engines, and is such that, although the steam be admitted throughout the whole of the stroke of the engine, or be cut off as a quarter stroke, or even less, the eduction in either case remains open throughout the full length of the stroke, and, therefore, obviates the objectionable back pressure always resulting from working expansively with one slide valve. The second part of the invention relates to apparatus for moving the eccentric or crank pin by which the slide valve of a steam engine is operated, so that the eccentricity shall be more or less, and give more or less throw to the valve, and also to traverse it to an opposite, or nearly opposite point of the shaft, whereby to reverse the action of the engine, as is well understood. Thirdly, the invention relates to other apparatus for traversing the eccentric pin or part that operates the slide valve across the shaft for the purpose of reversing the engine or for working more or less expansively. *Patent completed.*

3153 D. MILLAR. *Improvements in apparatus for moving heavy bodies.* Dated December 20, 1864.

The essential feature of this invention consists in the employment of two winding barrels acting simultaneously, but in such a way that, whilst one takes up the chain or rope, the other gives it off at a different rate. *Patent abandoned.*

3154 W. E. GEDGE. *An improved box for preserving velvets, ribbons, and similar articles.* (A communication.) Dated December 20, 1864.

This box is made the size of the piece it is to receive, is flat on its two faces, and rounded at the two ends, in order that the piece of velvet may preserve a perfectly graceful form. The top of the box opens and shuts with a hinge, like a snuff box, which arrangement permits the placing of the pieces of velvet within it, and its inspection at pleasure. On the front side of the said box is a long slit, by which one of the ends of the piece of velvet passes to the outside; thus it is only necessary to pull this end to pull out the quantity of velvet required, and the piece of velvet or ribbon remains in the box, from which there is withdrawn each time but the quantity sold. An india-rubber spring, similar to that used for raising the window blinds of a carriage, might be used to draw back into the box any excess of velvet which might be pulled out through the slit. *Patent abandoned.*

3155 H. DRAKEAU and P. LAIDET, sen. *An improved double suction pump, suitable for pumping big water out of ships.* Dated December 20, 1864.

We cannot here give space to the details of this invention. *Patent completed.*

3156 S. E. PETTER. *Improvements in means or apparatus for signalling between passengers and guards or others in charge of railway trains.* Dated December 20, 1864.

The inventor proposes to avail himself of the line or cord hitherto employed, passing from end to end of the train, and in addition to cause such line or cord to pass at each carriage through a separate loop or eye, connected to a cord or cords communicating with the respective compartments of the carriage, so that, when any one of these cords is pulled, the line extending from one end of the train to the other will be drawn aside, so as to effect a signalling to each end thereof, to the guard or driver or others in charge of such train. And he also applies to each compartment a flag or other suitable signal, which, except when acted upon for signalling purposes, lies in a case or cover or tube provided for it, but which is in connection with the cord for acting on the continuous line from the compartment to which it belongs. Each of these cords

when pulled acts on an internal tube, to which is attached a spring, which is free to work through a slot in an external tube, and is attached to the flag or other signal to draw it out of its cover and bring it into view. The external tube containing the internal tube with spring signals he prefers to locate on the top of the carriage, near the side of it, so that the signals may be seen either at the top or the side thereof, and so that at night they may be manifested by the side lights. By these means the cords of several signals may freely pass through the internal tube of each, and the tubes serve to protect the parts from injury. *Patent abandoned.*

3157 P. CAMERON and T. BOWMAN. *Improvements in textile fabrics, and in the machinery or apparatus employed for producing the same.* Dated December 20, 1864.

This invention essentially consists in forming numerous ornamental veins, which it is preferred to name as the "Princess veining," in the direction of the length of the cloth, or, as it is termed by weavers, "up the loom;" or they may be formed in the transverse direction. The nature or formation of the veins in the cloth is in imitation of those patterns ordinarily produced by the use of needles by hand; these veins are effected in a more perfect manner than has hitherto been done by machinery. The machinery by which these improvements are effected consists in adding to the ordinary loom an additional number of treadles attached to an additional leaf of treadles for actuating those portions of the ways in which the above-named veining is produced; the warp is actuated in such manner that on either side of the central threads of the vein, one or more warp threads are lifted or depressed, so as to be clear of the shuttle when it passes across, and the central threads are intertwined with the transverse threads so as to form the pattern. *Patent abandoned.*

3158 G. LEACH. *An improved fastening for books, pocket books, portfolios, satchels, bags, writing cases, and other analogous articles.* Dated December 20, 1864.

This fastening consists of a series of tubular pieces which are secured alternately to the sides of the book, and are so arranged that, when the book is closed, the tubular pieces are brought into a continuous line, and form a tube down which a straight lead pencil or pencil case or pen may be passed, so as to prevent the several parts from being drawn asunder without withdrawing the pencil or pen. In order to prevent the pencil or pen from being drawn out a spring catch is adapted thereto. The nib of this spring catch is made to project from a notch or hole in the side of the pen or pencil case, and take into a notch, or into a groove, or under a shoulder made inside one of the tubular pieces. In order, therefore, to withdraw the pen or pencil so as to open the book, the projecting nib of the spring catch must be drawn back. This is effected by means of a key or other suitable instrument, which is inserted through a suitable opening at the end of the pen or pencil case, and is made to bear against the spring catch and force it back, so that the pen or pencil may then be drawn out. *Patent completed.*

3159 T. A. GRIMSTON. *An improved apparatus to be used with breech-loading fire-arms, so as to render them available for use as breech-loaders or muzzle-loaders, as may be found convenient.* Dated December 20, 1864.

This invention consists in the employment of a metallic case of peculiar construction, which is placed in the rear end of the barrel so as to form a case or chamber to receive the charge. This case, which may be denominated the cartridge case, is made of any suitable metal, and is similar in shape to the cases of the ordinary pin cartridges at present in use for breech-loaders. The pin of the improved apparatus is separate from the metallic case, and is perforated throughout its length, and provided with a nipple at one end and a screw thread at the other; the intermediate space between the nipple at the top and of the screw at the bottom is of the same diameter as the pin of the common cartridge, and, consequently, it will fit easily into the pin hole of the gun. This pin may be screwed into the metallic cartridge case until the base of the nipple rests upon the gun barrel, which latter is protected from injury by a leather or other kind of washer that is placed between it and the nipple. The gun barrels being thus provided with a case to hold the charge, and a nipple to receive a cap, the fire-arm may, in every respect, be loaded and treated as a muzzle-loading gun, and may be fired by means of percussion caps placed on the nipple in the ordinary manner, but the barrels may nevertheless be used as a breech-loading gun again whenever required by withdrawing the improved metallic cartridge case and nipple, and using the ordinary pin cartridges. *Patent completed.*

3160 H. BIRD. *Improvements in treating sewage matters.* Dated December 20, 1864.

This invention consists in combining a compound called sulphated clay with sewage waters or matters, by which the organic matters therein are decolorised, the ammonia fixed, and when permitted the organic matters are precipitated with the clay, leaving the water pure, or comparatively pure; and the invention further consists in combining sulphuric acid or sulphated clay with the precipitated matters in order to render them more suitable for manure. *Patent completed.*

3161 S. P. A. DE B. D'ELUSA. *A new or improved manufacture of artificial manure.* Dated December 20, 1864.

The inventor designates the new compound a cerealine or new product; it is produced by the solidification of urine. The materials or substances he employs are as follows:—1, crushed or pulverised bones, or bone dust, or animal black, known as animal charcoal, about ten parts; 2, any species of the broom or heather plant and root ground to powder, about three parts; 3, the waste powdered iron or waste iron from forges, about one part; 4, oyster shells reduced to powder, about five parts; 5, oil of the pine turpentine or extract of resin, about one part. Each of these materials in their order should be mixed separately and be well amalgamated with urine before the whole are mixed together; a quarter of an hour is sufficient time for the mixture of each substance. The oil of resin or turpentine last employed requires a careful manipulation for an hour. In a week the cerealine may be reduced to powder and applied as a manure in the field. The material should be moulded in blocks and ground to powder when it is required for use. *Patent abandoned.*

3162 W. MAYNES. *An improved picker band, used in looms for weaving.* Dated December 20, 1864.

In performing this invention the inventor makes the picker band of iron, steel, or other suitable metal, thus making it a metallic picker band, and attaches one end of it to the picker and the other to the picking peg by means of a pin or other suitable contrivance, so that each

end will act as a swivel, and, in working the picker, will have a loose motion, giving and taking a little, so as to compensate for the rigidity of the metal, and accommodate itself to the flexibility of leather or similar material. *Patent abandoned.*

3163 J. P. Y. LLAGOSTERA. *Improvements in machinery for spinning cotton and other fibrous materials.* (A communication.) Dated December 20, 1864.

This invention has reference to driving the spindles in spinning machines, and consists in effecting this by means of a rolling friction from a wheel or drum made of or covered with leather, or other suitable material of sufficient elasticity, and affording sufficient adherence to or against the part of the spindle which is thereby driven. Also in driving such spindles in manner as above set forth, and in pairs, that is to say, two from each wheel or drum, a number of such wheels or drums so actuating their pairs of spindles being driven by bevel or other gearing, or in any other convenient manner. Also in making movable (instead of fixed) the steps or bottom bearings in which the spindles revolve, and causing them to be pressed towards the wheels or drums by wedges with weights suspended from them, or by springs, so as to keep the spindles fairly and properly in contact with the peripheries of the drums. *Patent completed.*

3164 H. A. DE BRIEU, jun. *Protecting and preserving metals, such as polished steel, silver plate, silver plated and electro-plated articles from oxidation, corrosion, and from the effects of damp or the action of sulphuretted hydrogen, and for cleaning and brightening said articles.* Dated December 21, 1864.

This invention consists in the use of a varnish composed of gum benzoin forty-five ounces, and alcohol or methylated spirit one gallon. The gum is dissolved by a slow heat and filtered. A coating of this varnish is spread over the surfaces that are to be protected by means of a flat camel's hair pencil or brush, and left to dry. The varnish is applied cold. To remove the varnish the patentee uses a liquid composed of collodion four parts, alcohol one part; and to wash the collodion off and clean the metals he uses a liquid composed of alcohol eighteen parts, and ether two parts; the surface is then dried with soft linen or carded cotton. *Patent completed.*

3165 T. WOODWARD. *Improvements in breech-loading fire-arms.* Dated December 21, 1864.

This invention consists, first, in the use of a chamber in connection with the barrel or barrels for receiving the cartridge, and having a slot or groove in its base to allow the free action to and fro of the extractor, for the purpose of removing the cartridge or cartridge case, and also having a slot or socket at the back into which a bolt in the breech is to enter, for the purpose of keeping the breech in position during firing, and removing same and opening the chambers in order to remove the empty cartridge case and reloading; secondly, in the use of a solid breech movable on a hinge or hinges, and which, when placed within the chamber, will form a recoil-bearing surface for the cartridge on the piece being discharged; thirdly, in the use of a bolt acted on by a spring in combination with the breech, and partly fitting into the slot or socket at the back of the chamber; fourthly, in the use of an extractor movable in the slot or groove in the base of the chamber for the purpose of withdrawing from the barrel or chamber the cartridge or cartridge case; fifthly, in connecting the barrel or barrels with the chamber by letting the rear end of the barrel into the chamber, and fixing or securing them together by a pin or other suitable means. *Patent abandoned.*

3166 J. WESTWOOD, jun. *Improvements in iron bridges.* Dated December 21, 1864.

These improvements are more particularly applicable to the lower horizontal members or tension chains of the variety of iron bridge girders for which J. Warren and W. J. Manzani obtained letters patent, dated August 15, 1848 (No. 12,243). The mode which the present patentee adopts for forming the lower or horizontal tension member of the Warren girder is as follows, the description proceeding from either end towards the middle of the length of the girder:—He takes one or more bars of a section or collective section proper for the lower tension link of the end triangle, but of a length sufficient to span horizontally along two or more triangles. Along that portion of the length of this bar or these bars which corresponds to the second triangle from the end of the girder, he applies another bar or bars of such section that, together with the first bar or bars described, the second bar or bars shall give the exact requisite strength for the lower tension members or links of the second triangle. The second bar or series of bars is of such length also that it spans the third triangle from the end, and in some cases it may be even longer. For the third triangle an additional bar or series of bars overlapping those of the second triangle is provided, and of such dimensions that, with the bar or bars already reacting along the third triangle, the exact requisite section shall be provided. In this way the lower horizontal member of the girder is formed of a series of overlapping bars or links, of such size and so arranged that the exact requisite section shall be provided in each triangle. *Patent completed.*

3167 O. F. BRYANT and S. MIDDLETON. *A mechanical chair, worked by foot or hand, for the purpose of brushing hair.* Dated December 21, 1864.

The first part of this apparatus consists of a chair made of wood or metal, with a treadle placed under it connected to a crank, for the purpose of driving a fly-wheel affixed to the chair; the second part consists of a roller or wheel to work at the side, back, or over the chair, attached thereto, and connected to the fly-wheel by a hand passing over a wheel at the end of the said roller; the third part consists of an endless elastic band passing over the said roller or wheel, or the patentees can use a non-elastic band made to yield by a spring attached to it; the fourth part consists of an ordinary circular brush with a grooved wheel at the end to receive the elastic band or belt, the brush to revolve on a spindle passed through the drum of the brush with fixed and loose handles at each end for the operator to hold. By working the treadle the whole of the machinery is set in motion, and the operator can guide the brush to any part of the head. *Patent completed.*

PROVISIONAL PROTECTIONS.

Dated May 18, 1865.

1375 B. T. BIRT, Otterbourne, near Winchester. *Improvements in traps used for catching rabbits and other animals*

Dated May 19, 1865.

1389 W. Clark, Chancery-lane, engineer. Improvements in the ornamentation of fabrics and leather. (A communication.)

Dated May 30, 1865.

1478 W. H. Stanley, Chipping Campden, Gloucestershire, civil engineer. Improvements in wickets for the game of cricket.

Dated June 1, 1865.

1506 H. Allman, Amptthill-square, civil engineer. Certain improvements in the manufacture of iron and steel, and in apparatus connected therewith.

Dated June 8, 1865.

1562 J. R. Cooper, Birmingham, gun manufacturer. Improvements in central fire breech-loading fire-arms.

1564 H. Hunt, Lewisham, house agent, and R. Hunter, Tottenham-court-road, upholsterer. Improvements in the manufacture of frames for looking glasses.

1565 S. Stell, T. Broughton, and F. Hall, Keighley, Yorkshire, worsted spinners. Improvements in apparatus employed in preparing and spinning wool, silk, flax, and other fibrous substances.

1566 J. Draper, De Beauvoir-road, Kingsland. An improvement in sewing machines, which improvement is also applicable to other machines driven by a strap or band.

1567 B. S. Cohen, Magdalen-row, Great Prescott-street, Goodman's-fields. Improvements in sheathing or coating the bottoms of ships or vessels.

Dated June 9, 1865.

1570 H. B. Fox, Oxtou, Cheshire. Improvements in the construction of the necks of bottles and other vessels, and in means for closing or covering the mouths of such bottles or vessels.

1571 W. W. Hulse, Manchester, engineer. Improvements in machinery or tools for cutting metals or other materials.

1573 W. E. Gedge, Wellington-street, Strand. An improved process for penetrating or impregnating woods with various substances. (A communication.)

1574 J. de Hemptinne, Ghent, Belgium, manufacturer. Improvements in the spinning of cotton and other fibrous materials.

1575 C. Vernon and W. Hodgkins, West Bromwich, Staffordshire, engine fitters. Improvements in safety valves, which improvements are also applicable to steam engine and other valves.

1577 W. H. Harfield, Royal Exchange-buildings. Improvements in apparatus for steering ships and vessels.

1578 G. E. Meek, Crane-court, Fleet-street, stationer, and W. H. Howes, Curtain-road, Shoreditch, looking glass maker. Improvements in fastenings for doors, windows, drawers, and other like purposes.

Dated June 10, 1865.

1580 J. Henderson, Cheapside, Bradford. Improvements in apparatus for printing wool, worsted, or other fibrous materials.

1581 A. H. Gilmore, Barsledon, Hants. Improved means or apparatus to be applied to doors and windows for the purpose of supporting or maintaining them in any required position when open, and in securing them when shut.

1582 R. A. Brooman, Fleet-street, patent agent. Improvements in kilns for firing porcelain and other ware. (A communication.)

Dated June 12, 1865.

1584 J. Glassebrook, cotton and cotton waste dealer, M. N. and B. R. Mills, machine makers, Ashton-under-Lyne, Lancashire. Improvements in sewing machines.

1586 J. E. Foynter, Glasgow, manufacturing chemist. Improvements in purifying paraffine.

1587 G. Haseltine, Southampton-buildings, Chancery-lane, civil engineer. An improved method of and machinery for cutting and excavating rock for railway tunnels and other purposes. (A communication.)

1589 G. Speight, Collingwood-street, City-road, collar manufacturer. An improved machine for curling or curling collars and cuffs.

1590 R. A. Brooman, Fleet-street, patent agent. Improvements in furnaces. (A communication.)

1591 J. Thomas, Battersea, iron founder. A new material to be used in the purification of heating and lighting gases.

1592 J. Hayes, Bow-lane, machinist. An improved construction of sewing machine.

Dated June 13, 1865.

1594 A. Robinson, Great George-street, Westminster. Improvements in the means and apparatus for firing and curing tea. (A communication.)

1595 G. Haseltine, Southampton-buildings, Chancery-lane, civil engineer. Improvements in fuses for shells or ordnance. (A communication.)

1596 J. A. Millington, Sandling-road, Maidstone, engineer, and A. Allnutt, Loose, near Maidstone, paper manufacturer. Certain improvements in machinery employed in and for the manufacture of paper.

1597 C. A. Hemingway, Dewsbury, Yorkshire, surgeon. An improved case splint for fractures.

1598 J. J. Bodmer, Newport, Monmouthshire. Improvements in the method of constructing partitions, walls, floors, and roofs of buildings.

1600 O. J. Collins, Upper Thames-street. A new or improved artificial fuel.

1601 J. H. Johnson, Lincoln's-inn-fields. Improvements in wheels for locomotive engines, railway carriages, and other purposes. (A communication.)

1602 T. Routledge, Ford, near Sunderland, and W. H. Richardson, Springwell, Jarrow-on-Tyne, chemical manufacturer. Improvements in the manufacture of paper and paper stock, and in the utilisation of certain waste products resulting therefrom.

1603 E. S. Horridge, Cheltenham, Gloucester. Improvements in communicating signals in railway trains.

1604 J. Griffiths, Old-street, Ludlow, Shropshire. An improved self-acting brake for four-wheeled carriages.

1605 F. A. Laurent and J. Castelaz, Rue St. Croix de la Bretonnerie, Paris, manufacturers. Improvements in the manufacture of phthalic acid and chloroxynaphthalic acid, and in dyeing and printing.

Dated June 14, 1865.

1606 H. G. Fairburn, St. Luke's, engineer. Improved machinery for compressing and solidifying coal and other analogous substances.

1607 B. and S. Massey, Openshaw, near Manchester. Improvements in hammers and other machines actuated by steam or other fluid or vapour.

1608 C. de Vendeuvre, Caversham-road, Kentish Town. A new or improved apparatus for the purpose of stopping and easing strains on ships' cables when in use.

1611 G. E. Keats, Leicester, and J. Keats, Street, Somersetshire. Improvements in sewing machines.

1612 W. R. Mulley, surveyor to Lloyd's register of shipping, Plymouth. Improvements in sheathing iron ships.

1613 S. Courtauld, Waddon, Surrey, and C. W. Atkinson, St. George's, Bloomsbury. Improved arrangements for opening and shutting carriage windows.

1614 H. Ormson, Chelsea. Improvements in multitubular hot water boilers.

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated June 22, 1865.

1678 G. Haseltine, Southampton-buildings, Chancery-lane, civil engineer. Improvements in sewing machines. (A communication.)

Dated June 24, 1865.

1693 P. A. Le C. de Fontaine-moreau, South-street, Finsbury. Certain improvements in machinery for the manufacture of horse-shoe and other nails. (A communication.)

LIST OF SEALED PATENTS.

Sealed June 30, 1865.

15 L. D'Anbréville	42 J. Lebandy
17 L. Goldberg	61 T. Horrex
18 G. Hodgson and J. Pitt	83 H. Coutanche
23 W. Ager	101 F. Barnes, D. Hancock, and E. Cowpe
24 D. Vericchio	139 J. S. Edge
32 J. W. Bransford	831 T. Farmer and F. Lewis
33 J. M. Kirby	893 W. E., and J. Gray
34 J. Skelton	

Sealed July 4, 1865.

28 W. H. Roy	139 G. T. Bousfield
40 J. E. Vigoulette	143 J. Robinson and J. Smith
47 W. C. Thurgar	177 W. Clark
55 G. B. Galloway	214 C. Roques
56 B. W. Bentley and W. H. Bailey	236 C. D. Abel
60 J. J. Blackham	318 R. Richardson
63 A. Barlow	323 E. and T. Williams
64 J. H. Johnson	329 W. Cockburn
68 W. Davies	483 J. H. Johnson
70 B. P. Bidder	488 W. E. Newton
71 F. Wiese	977 C. H. Williams
74 J. C. Brown	1060 J. Rippon
84 A. F. Lendy	1067 U. R. Fisher
100 W. Russ	1117 W. Scarratt and W. Dean
106 G. H. Daw	1263 S. Bennett
111 W. Brookes	1271 W. Clark
119 G. Davies	
129 F. C. Fourgeau	

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, July 4, 1865.

- 480 C. W. Homer. Making bricks.
 489 J. Keighley and R. Shepherd. Circular box looms.
 494 J. Dodgeon, J. Gaukroger, and W. Shackleton. Looms.
 498 J. Carter. Ventilating hats.
 504 G. Sinclair. Signalling in railway trains.
 518 C. W. Lancaster. Cartridges for breech-loading guns.
 524 J. Shortridge. Chain cables.
 525 C. J. Rowe. Portable invalid tables.
 528 J. Hundy. Raising weights.
 533 J. H. Rawlins and J. Chappell. Manufacture of paper.
 534 F. Claudet. Iron ores.
 537 J. Askew. Teaching children to walk.
 547 C. Ching. Fluid valve.
 548 M. B. Nairn. Treatment of floorcloths.
 558 G. Lauder. Mining coal. (A communication.)
 560 A. Davy. Solid iron scales.
 563 D. Chalmers. Textile fabrics.
 566 J. Hartshorn and W. Redgate. Lacs.
 568 T. S. Hall. Gas burners.
 569 J. B. Toussaint. Galters.
 572 G. H. Barth. Refrigeration of vapours.
 578 W. E. Kochs. Beams.
 583 S. Brooks. Looms.
 589 P. Rothwell. Vehicles drawn by horses.
 590 W. E. Newton. Impregnating wood with chemical solutions. (A communication.)
 602 L. Thomas. Side propellers for vessels.
 603 H. A. Bonnevillie. Drying apparatus. (A communication.)
 604 H. A. Bonnevillie. Rinsing by centrifugal force. (A communication.)
 610 L. Lo C. Cottam. Fitting sliding partitions in stables.
 611 R. A. Brooman. Motive power. (A communication.)
 615 W. E. Newton. Tobacco. (A communication.)
 618 E. Pettitt. Photographic pictures.
 622 S. and W. Smith. Combing wool.
 628 T. Nicholson. Caustic liquor.
 638 W. Clark. Cork-cutting machinery. (A communication.)
 639 W. Clark. Shoes for horses. (A communication.)
 652 F. W. Turner. Grinding corn.
 654 W. Clay. Iron forgings.
 658 E. Carchon. Closing spatterdashers.
 662 R. G. Fisher. Rolls for connecting sheets of zinc.
 668 G. F. Ansell. Indicating the presence of explosive gases.
 699 J. Atkins. Metallic bedsteads.
 703 J. Webb. Utilisation of materials for making paper. (A communication.)
 727 W. E. Newton. Distilling oils. (A communication.)
 808 G. E. Donisthorpe. Washing wool.
 912 H. A. Bonnevillie. Iron rods. (A communication.)
 917 J. Bathgate. Gas meters.
 1017 C. F. Gheerbrant. Deepening the bottoms of rivers.
 1209 G. Johnson. Iron fortifications.
 1282 R. H. Twaddell. Fixing the ends of boiler tubes.
 1345 H. Besley. Corn drill.
 1418 H. Nunn. Mangle.
 1499 W. E. Newton. Carpets. (A communication.)
 1492 J. Hayes. Sewing machine.

1594 A. Robinson. Firing and curing tea. (A communication.)

1606 H. G. Fairburn. Solidifying coal.

The full titles of the patents in the above list can be ascertained by referring back to their numbers in the list of provisional protections previously published.

Opposition can be entered to the granting of a patent to any of the parties in the above list who have given notice of their intention to proceed, within twenty-one days from the date of the *Gazette* in which the notice appears, by leaving at the Commissioners' office particulars in writing of the objection to the application.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

1876 J. Parkes	1929 T. L. Atkinson
1901 J. Tatham	1935 G. Bedson
1912 W. Easton and G. Donkin	1948 J. Howard and J. Bullough
1913 T. Parker	1953 A. Warner
1922 J. M. Dunlop	

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

1481 H. W. Wimshurst	1504 J. G. Jennings and J. Lovegrove
1486 K. Lord	
1602 J. G. Jennings	

LIST OF SPECIFICATIONS PUBLISHED.

For the Week ending July 1, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	
a. d.	s. d.	a. d.	s. d.	a. d.	s. d.	a. d.	s. d.	a. d.	s. d.	a. d.	s. d.	
1958	0	4	1998	1	6	2018	0	2023	1	2	2028	1
1961	0	4	1999	0	10	2019	0	2024	6	8	2029	0
1965	0	4	2002	0	6	2015	0	2026	0	4	2032	0
1876	0	10	2005	0	6	2011	0	2021	0	1	2027	0
1987	0	10	2012	1	2	2017	0	2022	1	4	2033	0

NOTE.—Specifications will be forwarded by post from the Great Seal Patent Office (publishing department) on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post Office order, made payable at the Post Office, High Holborn, to Mr. Bennett Woodcroft, Great Seal Patent Office, 26, Southampton-buildings, Chancery-lane.

LATEST PRICES OF MATERIALS USED IN CONSTRUCTION.

TIMBER, duty 1s. per load, drawback 1s.											
Task	load	£12	0	£13	0	Archangel, yellow	£13	10	214	1	0
Quebec, red pine	3	10	4	16	10	St. Petersburg, do.	11	0	13	0	0
yellow pine	2	10	3	13	10	Finland, do.	8	0	10	0	0
St. John, N.B., yellow	0	0	0	0	0	Memel	10	0	15	0	0
Quebec oak, white	5	6	0	0	0	Gottenburg, yellow	10	0	11	0	0
" birch	3	10	4	0	0	white	9	0	9	0	0
" elm	3	10	5	0	0	Galle, yellow	10	10	11	0	0
Danish oak	3	5	6	5	0	Soderu amu	9	10	11	0	0
" fir	2	15	3	10	0	Christiania, per C.	12	0	13	0	0
Memel fir	3	10	4	0	0	12th, by 3 by 9 in.	18	0	23	0	0
Riga	3	10	5	0	0	Swedish	10	0	11	0	0
Swedish	2	10	3	15	0	Desat lank, Danish	10	0	11	0	0
Masts, Quebec red pine	6	10	8	10	0	or 40 ft. 3 in.	0	14	1	0	0
yellow pine	6	10	8	10	0	POMICA STONPRTON	0	14	1	0	0
Lathwood, Danish, fm	7	10	8	10	0	Oila, do.	0	14	1	0	0
Deal, per C., 12 ft. by 3	8	10	9	10	0	Seal, pale	40	0	42	0	0
by 9 in., duty 2s. per						Spermin body	50	0	0	0	0
load, drawback 2s.						Cod	50	0	61	0	0
Quebec, white spruce	14	0	18	0	0	Whale, 8th Sea, pale	41	0	45	0	0
St. John,	13	0	18	0	0	Olive, Gallipoli	53	0	54	0	0
Yellow pine, per reduced C.						Cocanut, Coch, ton	410	0	45	0	0
Canada, 1st quality	18	0	20	0	0	Palm, true	37	10	0	0	0
" 2nd	13	0	14	0	0	Lined	33	10	33	15	0
						Rapeseed, Eng. pale	44	10	0	0	0
						Cottonseed	26	10	24	0	0

METALS.

IRON.

Welsh Bars, in London	per ton	£ s. d.	to	£ s. d. ps
Nail Rods	-	7 15 0	to	8 0 0 24
Hoops	-	8 0 0	-	9 0 0
Sheets, single	-	10 10 0	-	11 0 0
Staffordshire Bars	-	8 15 0	-	9 0 0
Bars, in Wales	-	7 0 0	-	7 5 0
Rails	-	7 0 0	-	7 5 0
Foundry Pig, at Glasg.	No 1	2 15 0	-	3 0 0
Swedish Bars	-	12 0 0	-	12 10 0 24

STEEL.

Swedish Keg, hammered	-	do	15 0 0	0 0 0
Swedish Pigot	-	-	16 0 0	0 0 0

COPPER.

Sheet & Sheathing, & Bolts	per ton	91 0 0	0 0 0 3
Hammered Bottoms	-	do	101 0 0
Flat Bottoms, not Hard	-	do	97 0 0
Cake and Tough Ingot	-	do	84 0 0
Best Selected	-	do	85 0 0
Fine Foreign Copper	-	do	92 0 0
Yel. Metal Sheathing & Rods	per lb.	0 7 4	0 0 8

LEAD.

Pig, English	-	per ton	19 0 0	21 0 0 24
Spanish Soft	-	do	18 10 0	19 0 0
Shot, Patent	-	do	25 10 0	0 0 0
Sheet	-	do	29 10 0	0 0 0
White	-	do	26 0 0	26 10 0

TIN.

English Block	-	per cwt.	94s 0d	0s 0d 24
do Bar	-	do	95s 0d	0s 0d
do Refined	-	do	97s 0d	0s 0d
Ranea	-	do	90s 0d	0s 0d not
Strait	-	do	92s 6d	93s 0d not

TIN PLATE.

Best Charcoal, I.C.	-	per box	1 8 6	1 9 6
Second Quality	-	do	1 8 6	1 7 6
Coke	-	do	1 3 0	1 3 6

SILVER.

On the spot	-	-	22 10 0	0 0 0 ne
-------------	---	---	---------	----------

ZINC.

English Sheet	-	-	27 10 0	2
---------------	---	---	---------	---

THE
MECHANICS' MAGAZINE.

LONDON: FRIDAY, JULY 14, 1865.

THE "FIELD" BOILER.

OF all the variously-constructed boilers in use for stationary purposes in England, not one has hitherto met with such universal adoption as the double-flue boiler. The type in general use consists of the cylindrical form, varying from five to seven feet in diameter, and having two cylindrical flues extending the whole length of the boiler, a furnace being placed in each flue. This admits of alternate firing so conducive to perfect combustion, and consequently, to the prevention of the smoke nuisance. For simplicity and effectiveness it is probably unequalled by any of the class to which it belongs. To its general efficacy and ability to fulfil the requirements of practice, is attributable its very general adoption. But there are conditions under which the double-flue boiler cannot be adopted. Space is often very valuable, and compactness then becomes an object, and the instances in which a special class of boiler is demanded are greatly on the increase. To meet this requirement multitubular boilers of varied arrangement have been constructed and used. As regards evaporation and economy of fuel, these boilers doubtless possess advantages over the double-flue class. But then they are more expensive, so that we may consider their chief recommendation to be their greatly reduced bulk and adaptability where space is either limited or valuable. There is, however, another point in connection with the multitubular boiler which should not be disregarded, and that is perfect immunity in respect of violent explosions. As compared with the double-flue boiler, it may be said to be perfectly safe, and this is due to the small diameter of the tubes in direct contact with the heat. But, notwithstanding the comparative efficiency of the multitubular boiler, experience goes to show that it is yet very far from perfect. In order to secure economy in consumption of fuel, with the rapid production of steam, it is essential that every means should be afforded for proper circulation, and thorough absorption by the water, of the heat generated. In these respects the multitubular boiler is seriously defective; unequal expansion and contraction, moreover, constituting a further great objection to which it is open. These defects, or shortcomings, it has been the object of many engineers to overcome, but in no instance has such perfect success attended the attempt as in the case of the "Field" boiler, so named after its inventor, and which was described and illustrated in our issue for the 17th of February last, as constructed for stationary purposes. The rapidity with which it generates steam has just received another practical illustration in the steam fire engine competition at Cologne, the report of which appeared in our last number. Messrs. Merryweathers' engine, which carried the first prize, was fitted with a "Field" boiler, and raised steam from cold water to a pressure of 100 lbs. per square inch in 7 min. and 28 sec. from the time of lighting the fire.

It will, doubtless, be remembered that the "Field" boiler was applied in the first instance to steam fire engines; but, as it was considered to possess many advantages which would render it valuable for other uses, steps were taken to test its efficiency for stationary purposes, and the result proved satisfactory in every respect. By no means the least important benefit derived from the adoption of this system, is the great saving effected in the space occupied, the dimensions of a steady working 80 nominal horse power "Field" boiler, including furnace, being only 6 ft. 6 ins. diameter by 8 ft. 8 ins. high. Then there is the further and equally important question of

safety already referred to, and which is certainly one of the first considerations in putting down a new boiler, especially in densely-populated localities. Upon this point we have no hesitation in stating our conviction that the system under notice is the safest form of steam generator yet introduced. In the event of shortness of water, the worst that can happen is the burning of some of the tubes, which, in fact, serve as fusible plugs, so that the fire is extinguished without further damage. This was actually proved, in a case of culpable neglect on the part of an attendant, under circumstances which must have resulted in a disastrous explosion had the boiler employed been a Cornish instead of a "Field." As it was, the main body or shell and the tube plate received no injury whatever, and the damaged tubes having been renewed, the boiler was very shortly again at work. Indeed, the facility with which the tubes may be renewed is remarkable, and constitutes another important feature in the boiler. It should also be mentioned that leakage is effectually prevented in consequence of the entire absence of unequal expansion and contraction.

In some climates boilers are especially subjected to the effects of frost; under these circumstances it might be inferred that the freezing of the water in the tubes of the "Field" boiler would be liable to cause them to burst. This, however, is found not to be the case. Tubes, of extra light make, and filled with water, have been purposely frozen and thawed four times in succession, so that the water throughout their entire length was on each occasion completely solidified. The result was simply that the inner tube was, for the time being, slightly raised, and immediately upon the ice being thawed it fell again into its proper position. In consumption of fuel, the "Field" boiler is found to be very economical, a fact mainly due to the rapid circulation of the water through the hottest part of the fire. The combustion attainable with water tubes pendent into the fire is far more perfect than in the case of boilers constructed according to the ordinary tubular systems. The peculiar arrangement of the "Field" boiler also enables the stoking to be more easily effected than is the case with most other steam generators. It has been advanced by some that the deposit of incrustation upon the tubes would, in many cases, form a serious obstacle to the adoption of this system of boiler. The truth is, however, that some of these boilers have been severely tested in steam fire engines, and found to be entirely free from deposit after over two years' constant use. In the case of a stationary boiler recently opened for quarterly examination it was found as clean and free from hard or scaly incrustation as on the day it was first worked. The only deposit found was at the bottom of the water casing surrounding the furnace, where it lay in the form of a light-coloured mud. On being dried this mud or paste resolved itself into a number of disintegrated particles, doubtless those which enter into the composition of the substances that ordinarily constitute the hard incrustation on the internal surfaces of boilers. But there is nothing particularly wonderful in this when the principle upon which the boiler is constructed is taken into consideration. From observation of the action of the "Field" boiler, as illustrated in a glass model of working dimensions, we were enabled to see that all extraneous matters were carried up by the circulation in the tubes, and thrown to the bottom of the water casing. From thence they may be blown out through a cock in the ordinary manner, and this was doubtless the case with the substances to which we have just referred.

It may be as well to note here the practical performance of the "Field" boiler, from which its merits will be clearly seen. The example taken is an 80 nominal horse power stationary boiler, the dimensions of which, as already stated, are 6 ft. 6 ins. diameter by 8 ft. 8 ins. high, no brickwork being required for setting

except in the ash-pit. The total area of heating surface is about 568 square feet, the external tube surface presenting 490, and the fire box 78 square feet. The fire-grate area is 22 square feet. The weight of fuel burned on each square foot of grate is about 20 lbs. per hour. About 18 cubic feet of water are evaporated from the initial temperature by 112 lbs. of fuel, which is about 10 lbs. of water for each pound of fuel burnt. The number of cubic feet of water evaporated per hour from initial temperature is 70.4. There are 8 square feet of heating surface for each cubic foot of water evaporated per hour, and the number of square feet of heating surface for each square foot of grate is 26. The temperature of the products of combustion escaping from the chimney rarely exceeds 600 degrees, although the temperature over the fire is upwards of 3,000 degs., this fact shows how efficiently the boiler absorbs the heat from the fire. Based upon the tried practical working of the principle, the conclusions at which we inevitably arrive are, that the "Field" boiler supplies the long-felt want of a compact, inexpensive, economical, safe, and thoroughly efficient steam generator. If anything were wanted to remove any idealism that might appear to attach to this boiler, it is supplied in the fact of its appreciation by practical men, as evidenced by a considerable number—some of large power—being at present in course of construction in this country and abroad for stationary and other purposes.

PUNCHED VERSUS DRILLED HOLES
IN BOILER-WORK.

OPINIONS differ very widely as to the comparative merits of punched and drilled rivet holes for work in general, but about so simple a matter as the riveting together of two plates something like unity of idea ought to be expected. But this is far from being the case. Punched boiler plates are advocated by some, whilst others strenuously support the drilling operation. There can be no doubt that the quality of the metal immediately around the punched hole must be injured to some extent by the splitting strain put upon the metal by the punch. This has, in fact, been shown to be the case by cutting open plates riveted with punched holes, and with drilled holes, when the difference in the state of the metal round the holes in the two cases was plainly observable. But apart from this consideration, and solely upon mechanical grounds, is the question debatable. The punched hole is slightly taper in form, and in the case of bridge-work, where a number of plates have to be riveted together to form one thickness, the punched holes would clearly not all be filled by the rivet. It could only be made to fill the holes in the two outside plates; and it would pass through the inside plates without touching them, except just at the smallest part of the hole. This is admitted by the advocates of punched holes, and it is further argued by them that this very fault of the hole in girder-work becomes the strong point in favour of its application to boiler-work. It is held that, for ordinary boiler making and similar purposes, when there are only two plates to be riveted together, a stronger joint may be made by punched than by drilled holes. To this end care must be taken to punch the plates the right way, and to place them together with the smaller ends of the rivet holes next each other. It is said that this allows the holes to be properly filled by the rivet, and that a section through the rivet, when in place, would show a form of increased strength for holding the plates together. Plates have been riveted together with both punched and drilled holes, and afterwards cut open down the centre of the line of rivets, so as to show in both cases how the rivets filled the holes. It was then clearly seen that the rivets filled the punched holes as perfectly as they did the drilled holes. But it must be borne in mind that these were

sample plates, and the whole secret of the matter lies in such careful and sound work as would be therein met with. But such care and such soundness certainly do not find their way into ordinary work in the present day, and therefore, notwithstanding the form of strength given to the rivet, or any other advantage claimed for it, the practical result of drilled will be found far superior to that of punched holes.

Anyone who has had frequent opportunities of witnessing the testing of high-pressure steam-boilers, sometimes with punched and sometimes with drilled rivet holes, will come to a conclusion in favour of the latter. No one who has had experience of drilled holes in this particular class of work will be likely to return to punched holes for such a purpose. However carefully a punching machine may be arranged, and however well the work may be put together, there still remains the objection that the punched holes are always conical, and render it difficult to fill the holes completely in hand riveting. Boiler explosions have occurred which are clearly attributable to bad riveting in punched holes. In the case of an explosion which occurred some years since at Huddersfield, Mr. D. Adamson made an examination of the boiler after the explosion, and he failed to find a single instance in which the rivet filled the rivet hole completely from one side of the plate to the other. There were also very few rivet holes that were at right angles to the plates, both the riveting and punching being exceedingly bad. This is unfortunately by no means a solitary or an extraordinary case of its kind, and there are a number of circumstances constantly operating to multiply the examples of such work. In punching holes too much depends on the care exercised by the workman, and it has been found that boiler plates punched on the Monday are not done so well as those punched later in the week. This arises from the men not being so careful and accurate on the first day of their week's work as they are afterwards when they get more into it. It is therefore very desirable to place it beyond the reach of the men to produce defective work. This may be accomplished by drilling the holes in the plates of all boilers which are to be subjected to a high pressure, and not only this, but at the same time drilling the two plates together in the position in which they are to be riveted up. This will enable a correct allowance to be made for the curvature of the plate, and render it impossible for the workman to produce irregular holes. When the plates are riveted together all the holes will coincide exactly, and every rivet will take its proper share of the strain.

In the case of the longitudinal seams of boilers say 6 ft. in diameter, made of 9-16th in. plates, to carry 100 lbs. steam, the single riveted joint is particularly unsafe, on account of the great shearing strain to which the rivets are subjected. Such a boiler, under a single test, may appear tight up to the testing pressure, but on subsequently raising the pressure rapidly up to the testing amount it will be found that the joints are not then tight, but will show signs of leakage or sweating in many places. This effect will be continued and increased in any subsequent testing when the pressure is raised quickly. This proves the insufficiency of a single test in trying boilers, and shows that a prolonged trial is necessary. The test may be repeated with advantage even fifty times a day, with intervals. By this method it has been found that in testing punched boilers for a day together, every time the pressure is put on there is more or less trickling from the joints. With drilled holes, however, the work is much more to be depended upon, and there is less of the ordinary sweating at the joints, nor is any serious leakage ever produced by repeatedly putting up the pressure rapidly. Hence, for locomotive boilers in particular, which are subjected to such rapid variations of pressure, it appears highly desirable that all rivet holes should be drilled, and also that the two

plates should be drilled together in the position they will take when riveted up. Single-riveted joints become impracticable in boilers of large diameter, say 7 ft., with $\frac{1}{2}$ in. plates, whether the holes are drilled or punched. The reason for this is, that the extra thickness at the lap of the joint throws the plate so much out of the true circle that every time the pressure comes upon them it springs the joint with a force which inevitably produces leakage when only a single row of rivets is used. A great deal of the external corrosion observed in boilers is due to the continual small leakages produced in this way by the variations of pressure. But there is a more serious evil, and one which is especially manifest in locomotive boilers; this is, that the constant springing of the joint has ultimately the effect of exfoliating the interior surface of the plates along the seam. The iron becomes guttered along the edges of the plates to such a depth through the thickness of the metal that in some cases locomotive boilers have exploded whilst working at the ordinary pressure. In riveting up punched work with steam or power-riveting machines, it is true that the rivets may be made to fill the holes, but it does not follow that the work, so put together, is as strong as if the holes had been drilled. On planing open the joint in the punched work it will be found that there is more or less irregularity in the holes, and, therefore, the rivets will not in all of them take their proper share of the strain along the whole length of the joint. But in drilled plates, where all the holes are drilled exactly at right angles to the plates, and when the rivets are accurately made so that each contains the same amount of metal as the other, and are afterwards put in the holes by a power-riveting machine, an unexceptionable joint is ensured. There can be no question that drilling possesses many advantages over punching: among others it affords greater security and much tighter work, which are especially desiderata in boiler work.

BEAUFUMÉ'S GAS FURNACE.

SMOKE is exceedingly picturesque, and even poetical, when curling in blue wreaths from a cottage chimney in a happy landscape. But it becomes an intolerable nuisance when belched forth in magnified proportions from the numerous chimneystacks of a manufacturing town. It may be pleasant when emitted from the cigar of a noble lord upon the platform of a railway station, although—as lately proved to be the case—magisterial authority may vote it a nuisance. But a much stronger case is made out against the products of combustion when issuing from the funnel of a locomotive. It therefore becomes all who can, to aid in the endeavour to relieve the atmosphere from its really preventable accession of carbon. In a recent article upon smokeless furnaces we referred in passing to the gas-flame furnace of M. Beaufumé. We purpose now more particularly to describe this apparatus, and to notice the results of some experiments therewith. This furnace differs very widely from most others, inasmuch as the fuel is transformed into gas in an apparatus apart from the boiler, and from which it is conveyed to the latter for effecting combustion. A furnace constructed somewhat similarly to that of a locomotive, but having a water space substituted for a tube-plate, forms the separate apparatus or gasifier. About 20, or sometimes 28 in. of coal are placed on the grate, and air is supplied beneath the bars by means of a blowing fan. Active combustion goes on among the lower layers of coal, owing to the oxygen of the air supplied. The coal becomes converted into carbonic acid gas, which, passing through the upper layers, becomes in its turn converted into carbonic oxide, and accumulates in the upper part of the furnace, mixed with nitrogen. These gases are maintained at a low temperature, and are conducted to a chamber called the burner, where they are well mixed with air,

and whence they are taken to the boiler furnace. The gases continue to burn, when lighted, as long as the supply is kept up; their flames acting on the heating surface of the boiler, and the products of combustion passing through the flues into the atmosphere, no chimney is required, the pressure from the blowing-fan obviating the necessity for one. Owing to the water which surrounds the gasifier, it is in itself a small boiler, and the steam produced in it is conducted to the large boiler. The gasifier is fed from the top by an arrangement of valves, which prevents communication with the external atmosphere. To adapt ordinary boilers for being heated with gas is a very simple and inexpensive matter. The fire-bars are replaced by a brickwork platform, on which numerous passages are formed in the same material, openings being left so that a portion of the ignited gases may come in contact with the boiler. The duty of these passages is to heat the gases, which, coming in cold, would not be completely burned were they not warmed before being ignited. The benefits obtained by M. Beaufumé's system are, in the first place, a very active and complete combustion, with a regular supply of air, never in excess; in the second place, a perfect consumption of smoke; and in the third, a considerable economy in fuel.

With the view of verifying the statements made respecting the advantages of this apparatus, M. Guesnot, Admiralty engineer, and M. Sochet, director of naval construction, experimented with it at Cherbourg, in 1857. The apparatus was applied to a 12 horse-power boiler, having a total heating surface of 167½ square feet, and which arranged in the ordinary way would have a grate surface of 12½ square feet. The gasifier had a grate surface of 5½ square feet, and was capable of accommodating a depth of 27½ in. of fuel. The apparatus was about 11 ft. 6 in. high, inclusive of ash pan and air passages below the bars, and occupied a space of about 290 cubic feet. A space about 10 ft. by 6 ft. 6 in. is sufficient for placing the apparatus, and this gives room enough for an attendant, but is exclusive of space required for the blowing-fan, and the donkey-engine which drives it. The latter has a cylinder 3.9 in., and a stroke of 7.9 in., its maximum speed being 170 revolutions per minute, with a pressure of five atmospheres. The blowing-fan has a velocity of about 1,000 revolutions per minute, and receives motion through a belt and pulley. The fan is 2 ft. in diameter by 1 ft. wide, and, when working at 1,000 revolutions, produces a blast equal to a column of water 1.97 in. high. The work to be performed by the attendant consists in raising the fuel to a stage ranging with the charging passage, and in introducing it through this passage when necessary, the height of the fuel being ascertained by a gauge-rod. The black coals lying above the incandescent mass require to be disturbed occasionally to prevent their becoming arched or hollowed beneath. Notice must also be taken of the burning gases in the boiler furnace, the speed of the blowing-fan must be regulated, and the registers upon the various air and water pipes adjusted; the water supply of both the main boiler and that of the gasifier must likewise be attended to. The fire-bars of the gasifier require cleaning occasionally, but this will be dependent on the quality of the fuel used. English coal renders the operation necessary at midday, and in the evening. Although the Beaufumé apparatus requires more careful attention than an ordinary boiler, yet it is perfectly within the capacity of an ordinary fireman to attend to it.

The rapidity with which steam can be generated depends on the time that has elapsed since the boiler and gasifier were last used. When working has been discontinued for twelve hours, or in other words, when the boiler and gasifier are cold, it takes longer to get up steam than in the ordinary furnace. The furnace and gasifier have to be worked in

the first instance like an ordinary furnace, to get up steam of the pressure of two atmospheres, which occupies about twenty-five minutes. Until this is done the blowing-fan cannot be set in motion, neither can gas be produced which is capable of being burnt under the large boiler. This is one inconvenience which is inseparable from this apparatus, unless the fire in the gasifier be kept in during the intervals between working hours. Another inconvenience is also obvious, for each time the fire is stoked small apertures have to be opened for the introduction of the poker, which causes the escape of large quantities of carbonic oxide, which is injurious to the attendant in the boiler-house, if the atmosphere be not quickly renewed. Upon igniting the gas in the boiler furnace explosions will occur if the air-supply is not shut off until the moment of applying the light. These explosions, however, are of a very trifling character, and in no way dangerous; owing to the very slight elevation in the temperature of the gases, the flames reach but a small distance. The results of the experiments made at Cherbourg with the Beaufumé apparatus show a great saving in fuel in the production of a given amount of steam. A standard of comparison was obtained by the experimenters from a boiler which was heated by the ordinary furnace, to ascertain the quantity of steam raised per pound of coal. Owing to defective settings only 4.85 lbs. of water were converted into steam of a pressure of five atmospheres per pound of Newcastle coal. On applying the Beaufumé apparatus, the same coal being used, the quantity of water converted into steam of a pressure of five atmospheres per pound of coal ultimately reached 8.26 lbs. This amount was arrived at by successive increments in a series of experiments, and was due to repeated improvements in the working of the apparatus. This result, however, is a saving of 41 per cent. in fuel in the production of a given amount of steam as compared with the previous defective evaporations. The amount of steam used by the donkey-engine driving the blowing-fan, should, however, be taken into consideration, which would bring the result to about 7.8 lbs.; even then there would be a saving of 38 per cent. in fuel.

A very imperfect method was adopted to ascertain the amount of steam produced; it was estimated by the quantity of feed-water used. But this was the only means by which it could be arrived at, owing to the irregularity in the amount of power used by the machinery, and further to the fact that more steam was produced by the Beaufumé apparatus than could be used. The consumption of smoke was observed to be most perfect; the only time at which smoke was at all visible was when the fuel was stirred, and the amount then was very inconsiderable, of a very light character, and lasted out for a few seconds. Notwithstanding the work done there was a considerable loss of heat, the products of combustion on leaving the flues being found of a sufficiently high temperature to melt zinc. In a subsequent series of experiments different coals were employed, small coal being first tried. The result in this case was 7.24 lbs. of water converted into steam of a pressure of five atmospheres per pound of coal. In the next trial Cardiff coal was used, and this showed 8.3 lbs. of water converted into steam per pound of coal. The third experiment of this series was made with a sample of a new coal then submitted for trial, known as Newall's Llanelly coal; the results, however, were less favourable than in the preceding cases, except the small, with which it was on a par, the quantity of water evaporated being 7.25 lbs. It was, however, considered that a better result might have been obtained by further trials of this coal.

In consequence of the Beaufumé apparatus having proved too powerful for the boiler in the previous experiments, it was afterwards applied to a marine boiler in order to determine approximately its maximum power. For this purpose one of the four boilers of the

"Antelope" was used, being then in the boiler yard, and in working order. By the addition of a little brickwork to the furnace it was fitted for the application of the Beaufumé apparatus, the fire-bars being replaced by a brickwork platform constructed with the necessary heating passages and apertures, and having a space of 20 in. between it and the roof of the furnace. The ash-pits were of course useless, and if entirely absent would have added about 114 cubic feet of available space. Being placed in the yard the boiler was unfavourably situated with regard to the trial; the weather being cold considerable loss of heat from the external surface ensued. The results, however, showed a mean of 9.20 lbs. of water evaporated per pound of Newcastle coal, and a maximum per hour of 1,884 lbs. of water evaporated with a corresponding consumption of 225 lbs. of coal. In the boiler the water was evaporated under atmospheric pressure, and in the gasifier, under a pressure of five atmospheres. Under the uncertain conditions of this trial absolutely precise conclusions were out of the question, but the deductions of the experimenters led to the opinion that 1,969½ lbs. of water per hour converted into steam at a low pressure might be taken as the maximum performance with the Beaufumé apparatus. Supposing an evaporation of 6.6 gallons per hour to be equivalent to a horse power, this gives 28½ horses as the maximum power. It follows that in this apparatus 40 lbs. of coal per square foot can be burned on the fire-bars. The fact that the gases left the boiler at a temperature as low as 302 deg. Fahr. proves that the heat developed was utilised as far as possible. The heating surface was very large as compared with the gas produced, so that, although in one instance 36 and in another 42 tubes out of the 106 in the boiler were closed, yet a very slight effect was perceptible. Whilst the figures show that the evaporation per pound of coal increased as the number of tubes was reduced, they also indicate a decrease per hour in the evaporation.

A good practical hint, bearing very closely upon the subject, may be gathered from the proceedings of a provincial firm, engaged, amongst other matters, in the manufacture of coke. They conduct the gases from the coking coal to the furnaces of their boilers, where it is beneficially consumed. This is not only so much gain to the public health by the diverting of a certain amount of poison from the atmosphere, but so much gain also to the proprietors; the advantages to them being a great reduction in the consumption of fuel beneath the boilers—a small quantity of slack only being required—and a consequent diminution of that bane of all cleanly people—smoke.

NOTICES OF BOOKS.

TEN years undoubtedly, now make a long period in scientific and technical progress. Of all the arts, the most rapidly advancing is that of mechanical engineering, and a decade may be sufficient to almost revolutionise many of its conditions. Time steals so imperceptibly on, each successive step further is made so gradually, that it is only by a consideration of such complete landmarks as universal exhibitions, or thoroughly-written technical works, that one can perceive or remember the differences originated in the course of ten years. It is now about that period since Mr. J. Bourne, of good and proved experience both as a writer and a practical engineer, published his excellent "Catechism of the Steam Engine," and thus, by this time, much of its information has become antiquated, not so much in itself as on account of the omissions that have necessarily occurred. This book, as well as the larger work on the steam engine by the same author, has obtained a wide circulation amongst engineers, and it was of importance that it should be brought up to the present state of things. The author has therefore made the few alterations in the original text, that as appeared to be "necessary to make the work

consistent with the best indications of modern practice," while he has prepared a separate introduction which may "be purchased separately by the possessors of the former edition."* He tells us that he has preferred doing this to "incorporating such a mass of new information in the body of the work itself as to render it inaccessible to all who did not feel disposed to purchase the entire volume."† The result is a small separate work of very great interest, both in itself and its subject, as also forming a separate introduction to the older "Catechism." We find therein a brief but masterly account of such recent steps in steam engineering as are indicated by the terms superheating, surface condensation, combined screw and paddle engines, marine governors, modern forms and proportions of boilers, smoke burning, the injector, coal-burning locomotives, ice locomotives, traction engines, steam ploughing, and steam fire engines. It is more especially on marine engines—to which department of engineering Mr. Bourne has given most practical attention—that this book is particularly valuable and interesting. The only thing one regrets is, that this, as well as the other subjects, are not treated on to a greater length, as the author evidently possesses vast experience and practical information. Of great interest is the article on steam jackets, recounting the modern explanation of their apparently mysterious efficiency in saving fuel. Contrary to the usual notion, the inferiority of the indicator diagram "is by no means measurable by the loss from radiation, but is a much larger loss, and arises from the fact of the inner surface of the cylinder being cooled and heated by the steam at every stroke of the engine." A number of diagrams are given, showing this very well. In fact, there is little doubt that in the absence of a steam jacket the cylinder acts somewhat as a condenser at the beginning, and as a boiler at the end of the stroke. Summarising the progress made of late years in the marine engine, Mr. Bourne thinks that, in spite of the many efforts made, not many improvements have been definitively introduced. The expectations as to the results attainable from superheating apparatuses have been exaggerated, and "it is now found that about the same amount of superheating which was obtainable in the old flue boilers is the most beneficial." The pressures used have been increasing in amount, "but the existing marine boiler is ill-adapted to withstand any considerable pressure," so that the risks of explosion have been increased under the present circumstances. Mr. Bourne does not believe that surface condensation will be permanently retained, "at least in its present cumbrous form." Amongst the improvements of inferior importance are the marine governor and the use of steel for screw and paddle shafts. The things now required in marine engineering are "boilers capable of enduring high pressures of steam with safety, and if salt water is used in the boilers, we require the introduction of some arrangement which will prevent the sulphate of lime from being precipitated on the heating surfaces, which takes place at a temperature answering to 40 lbs. pressure of steam without any concentration of the water at all." Amongst the further requirements of the marine engine, and, indeed, of the steam engine generally, is a self-acting apparatus for feeding the fire, and also a means for preventing smoke. It is not improbable that both desiderata will be fulfilled by one and the same apparatus. Burning coal without smoke can scarcely be said to be in quite successful operation on locomotives, though

* "Recent Improvements in the Steam Engine, in its various Applications to Mines, Mills, Steam-navigation, Railways, and Agriculture; being an Introduction to the 'Catechism of the Steam Engine.'" By JOHN BOURNE, C.E., &c. London: Longmans, 1865.

† "A Catechism of the Steam Engine in its various Applications to Mines, Mills, Steam-navigation, Railways, and Agriculture; with Practical Instructions for the Manufacture and Management of Engines of every Class. To which is prefixed an introduction descriptive of all recent Improvements." By J. BOURNE, C.E. London: Longmans, 1865.

the substitution of coal for coke is now all but universal. As is here very well observed, locomotives of late years "have been gradually sliding into the use of coal; and the probability is, that the nuisance will go on increasing until it becomes intolerable and is finally subverted by the strong hand of power." We rather differ from Mr. Bourne's adverse opinions of the foreign locomotives sent to the great Exhibition. As we pointed out at the time, foreign railways generally have been built at cheaper rates, and with less of the feeling against steep gradients and sharp curves which has animated English practice. The result is that heavier and necessarily rather more complicated engines have been found requisite. Mr. Fell's locomotive, with a central rail, now being used on Mont Cenis, is not noticed here. An important step in locomotive construction is the plan introduced by Mr. Ramsbottom, of Crewe, for supplying water to tenders while running. It is not generally known that the idea can be found embodied in an article and engraving published long ago in the *Scientific American*. Its practical introduction, however, dates within the last ten years, as is also the case with steam ploughing and the consequent application of locomotives to common roads. The growing importance of these applications of steam to agriculture is shown by the Act which was passed last Wednesday week for facilitating the use of traction engines. In England, the main value of these road engines consists in their use for steam ploughing, though, no doubt, they will also be found of use for feeding the traffic of railways. Their function in this direction is, however, of more importance in an undeveloped country where "the construction of expensive lines of railway in districts covered with jungle and destitute of population cannot be justified by any principle of reason or any indication of common sense." But by running traction engines on metalled common roads, the traffic may be nursed up by degrees to a certain point of magnitude, when it may become remunerative to lay down a regular line of rails. For steam ploughing, Mr. Bourne advocates a rotary steam digger. This plan has been fully tried, and at very great expense, by Mr. Romanie and others. It was found that the greatest portion of the power of the engine was consumed in moving itself, while the moving parts, subjected to heavy and unequal strains, very soon got out of order. We feel rather surprised that Mr. Bourne has not mentioned the name of the late Mr. John Fowler in connection with steam ploughing. Another novelty of introduction during the last ten years are steam fire-engines. They are rapidly spreading in all parts of England and the continent, though, apparently, but a comparatively small number of makers have taken up their manufacture. An important application of the steam engine, destined to render great hygienic services in hot countries, as also to various branches of the manufactures, is to making ice, either by forcing the heat out of air by mechanical compression, and then allowing it to expand, or by combining this system into the refrigerating agency of expanding ether.

There are two principal ways in which further improvements in the steam engine may be made. The first is by economising the fuel; Watt's condenser was neither more nor less than an improvement as to economy, and the condenser first brought into practice a steam engine consuming a particularly moderate amount of fuel. It is not perhaps generally known that Newcomen's engine was more or less in use nearly sixty or seventy years before Watt. The present engine, however, wastes about nine-tenths of the fuel used in the grate. It is more than probable that the real and substantial improvement in the present engine may be looked for from a complete appreciation and working out of Joule's dynamic equivalent of heat. The other main directions for improvements in the steam engine may be said to consist in making it

more and more special; in adapting more and more its different applications to the special requirements of each case. At the outset Watt's beam engine was put to all kinds of work, to pumping, to working light machinery, and even to marine purposes. But now the more the special requirements of each special case are attended to, the greater is the commercial gain, and in this direction the steam engine may be said to be undergoing modification in the same way as special tools are being constructed for particular purposes.

The judicious use of the accumulated labour of calculated tables may save an enormous amount of time and trouble in the ordinary concerns of life, and we thus witness a continual multiplication of these useful works of reference. They are being adapted to all classes of technical workers, and the little volume before us is more especially intended for buyers and sellers of timber.* It is intended in the first place as a handbook for the timber merchant, "in order to facilitate, as much as possible, the intricate calculations necessary for fixing exact cost in wood goods." The different tables are arranged with equivalent values for quantities in dollars, currency and sterling, when referring to North American markets. There can be no doubt that the tables comprised in this work must afford material assistance to the timber merchant. For the builder and salesman there are lists of comparative values for joisting, flooring of all kinds, lists for roofing, slating, lathing, stonework, brickwork, painting, glazing, &c. A book of a similar kind, but intended more especially for the millwright and engineer, has also been lately issued by Messrs. Spon, who make it their *specialité* to cater for the literary wants of the engineering public.† It is certainly calculated to be of great practical service in the workshop. It contains a very full series of tables of the diameter and power of wheels; of the diameter, weight, and power of shafts; of multipliers for finding the average pressure of steam for engines worked expansively; for finding the sizes of Whitworth's threaded bolts to carry a given maximum strain per square inch of each motion; of the sizes and weights of hexagonal nuts; of governor speeds; of the contents of the working barrels of pumps; of the weights of boiler plates 1 ft. wide and of various thicknesses and lengths. It is worth remembering here that the weight of one superficial foot of $\frac{1}{2}$ in. plate is exactly 20 lbs. The great danger about tables like these is that they often contain errors. As far as we can see, this is not the case here, and the wants these tables supply are certainly those of the practical man. As is well noticed with respect to wheels for iron rolling mills and similar works, "the wheels are liable to very great irregularities and unavoidable back-lash; consequently they require to be made stronger, for the same power of engine;" and thus, in proportioning gearing of this kind, experience is the only sure guide. A set of tables of circumferences and areas of circles, as also of such useful conversions of English into French measure as, "pressure in pounds per square inch, and in kilogrammes per square centimetre and per square millimetre," are added at the end of the book. Between each separate set of tables are bound a number of blank leaves—as we, indeed, suggested some time ago—for any memoranda which may be specially required by the possessor of the work.

The author of this pamphlet‡ joins issue with the opinion expressed in the Sewage Report of the Select Committee on Metropolitan Sewage (Session 1864), that "no artificial

method has been discovered to purify water for drinking and culinary purposes which has been infected by town sewage." In these pages he describes a plan for purifying water affected in this way, and he undoubtedly deserves some attention from the public, more especially as his name has been already honourably known for valuable practical applications of chemical science. Mr. Spencer states that very impure water is almost perfectly purified by passing it through magnetic iron oxide. He prepares this by placing granulated Cumberland ore in an iron retort along with sawdust, and the whole luted up, leaving a small aperture for the escape of moisture and the carbonic oxide, should it be formed. With some further manipulations, and after discharging the retort after cooling, the formerly inert ore was found converted into a black, highly magnetic, granulated oxide, which, for all purifying purposes, was found as powerful as that from Spathose ore. That such an effect is produced is clearly an important discovery, and the results in practice would seem to bear out this view. Numerous domestic filters have been made on this plan, and they have been in successful use for a long time. On a large scale, Mr. Spencer's "magnetic carbide" has been employed at Spalding, in Lincolnshire, for some four or five years, for purifying the coloured fen water and thus supplying the town. Messrs. Easton and Amos put up the waterworks of that place, and, a considerable time after the plan had been in operation, they sent Mr. Spencer a letter testifying to its success. It is also in operation at Wakefield, and Mr. Digby Wyatt describes the effect of the carbide on sewage water as being "magical." Mr. Spencer states that his pamphlet was hastily written in order to meet the allegations contained in a measure introduced to the House of Commons during the past session by Lord Robert Montagu, "to prevent the emptying of town drainage into rivers," on the plea that the water could not be again purified. It seems that Mr. Spencer was, somehow, not allowed to give evidence in the matter before the committee, and, considering that public attention should be directed to this important subject, he publishes this pamphlet as a sort of manifesto of his views. We should be glad indeed to see the time when our rivers are no longer used as sewers, but even that expectation should not have prevented the committee from hearing Mr. Spencer's evidence on what appears to be a discovery of great value.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

The Thermic Equivalent of Magnesium—Another Method of Obtaining Oxygen—Influence of the Heat of the Discharge upon the Path of the Induction Spark.

DR. THOMAS WOODS, of Parsonstown, has communicated to the *Philosophical Magazine* an account of some experiments made to determine the "thermic equivalent" of the metal magnesium, from which it appears that an equivalent of magnesium, in combining with an equivalent of oxygen, produces a greater amount of heat than is produced under similar circumstances by an equivalent of any other substance with which we are acquainted. Potassium and sodium have hitherto been regarded as possessing the highest thermic equivalent of any known substances, but Dr. Woods shows that the heat evolved by those metals, in undergoing combination, is not so great as that evolved by magnesium. In combining with one grain of oxygen, an equivalent of potassium evolves as much heat as will raise the temperature of one thousand grains of water 17.5 degrees Fahrenheit; but an equivalent of magnesium, in combining with one grain of oxygen, evolves heat enough to raise the temperature of a thousand grains of water 19.2 degrees. The equivalent of potassium would weigh nearly five grains, but that of magnesium

* "The Timber Importer's, Timber Merchant's, and Builder's Standard Guide." By RICHARD E. GRANDY. London: Lockwood and Co., 1865.

† "The Practical Millwright's and Engineer's Ready Reckoner; or, Tables for finding the Diameter and Power of C-g-wheels; Diameter, Weight, and Power of Shafts; Diameter and Strength of Bolts, &c., &c." By THOMAS DIXON. London: E. and F. N. Spon, 1865.

‡ "The Sewage Committee of 1864, and its Report as to the Purification of River Water from Town Sewage." By THOMAS SPENCER, F.C.S., &c. London: Edward Stanford, 1865.

only one and a half grains; so that, in combining with oxygen, a given weight of magnesium evolves something over three and a half times as much heat as is evolved by an equal weight of potassium. Dr. Woods has compared the thermic equivalent of magnesium with that of zinc, the middle term of the "triad," composed of magnesium, zinc, and cadmium, to which magnesium belongs, and he shows that the heat developed by the oxidation of an equivalent of the former metal is just double that produced by the oxidation of an equivalent of the latter. An equivalent of zinc, in combining with one grain of oxygen, will raise the temperature of a thousand grains of water 9° degrees, or to just half the extent to which the temperature of the same quantity of water would be raised by the heat developed by the combination of an equivalent of magnesium with one grain of oxygen. As the equivalent of zinc would weigh four grains, a given weight of magnesium evolves during oxidation more than five and a half times as much heat as is produced by the oxidation of an equal weight of zinc. The case is exactly similar as regards the heat developed by combination with chlorine. In combining with that element, a quantity of magnesium equivalent to one grain of oxygen produces as much heat as would raise the temperature of a thousand grains of water 25·2 degrees, whereas an equivalent of potassium, in combining with chlorine, evolves only heat enough to raise a thousand grains of water 22·9 degrees, and an equivalent of zinc only heat sufficient to raise the temperature of the same quantity of water 11·25 degrees.

Within the last few weeks we have described two new methods of obtaining oxygen on the great scale. A third method is set forth in a recent number of "Cosmos." M. Archereau, the inventor of a furnace upon much the same principle as that of Siemens's "regenerator," proposes that this furnace should be used for the obtaining of oxygen and sulphurous acid by means of the reaction which has long been known to take place at a high temperature between silica and sulphate of lime. In the form, the one of sand, and the other of "gypsum," these two bodies exist so abundantly that the idea of obtaining sulphuric acid, on the industrial scale, by decomposing the latter by the former, has long been a favourite one with chemists; but its practical realisation has never been accomplished, owing to the exceedingly high temperature which is necessary to effect the decomposition. M. Archereau declares, however, that by means of his furnace there may be obtained, cheaply and easily, not only a temperature at which sand, or silic acid, will decompose gypsum, combining with the base of that compound to form silicate of lime, and setting its sulphuric acid free, but a temperature at which sulphuric acid undergoes "disassociation," and is resolved into sulphurous acid and oxygen. His proposed method of obtaining oxygen therefore consists in submitting, in a furnace constructed on his plan, a mixture of sand and sulphate of lime to a temperature at which silicate of lime is formed on the one hand, and a gaseous mixture of sulphurous acid and free oxygen on the other. He would separate the sulphurous acid, and so obtain the oxygen by itself, by subjecting the mixture to a pressure of three atmospheres, by which the sulphurous acid would be liquified. We need hardly say that the sulphurous acid could afterwards be converted into sulphuric acid by the ordinary means. M. Archereau calculates that oxygen could be obtained by this method at a cost not exceeding thirty-five centimes per cubic metre, or something less than one halfpenny per cubic foot.

M. Fernet has found that the heat which the induction-spark communicates to the air through which it passes exerts a remarkable influence upon the path of the spark. To the ends of the induction-coil of a Ruhmkorff's apparatus he attached two small straight

brass rods, about two decimètres long, placed, in a vertical plane, at a few centimètres apart, but so that their lower ends were somewhat nearer together than their upper ends. With this arrangement, he found that the sparks which pass at each oscillation of the commutator appear first between those parts of the rods which are nearest together,—that is to say, between their lower extremities. "Soon, however," says M. Fernet, "they cease to pass at this point, and appear at a higher part, until they reach the highest, when the discharge suddenly ceases. The spark now passes below again, and the same series of phenomena is repeated. The duration of the impression has, moreover, the effect that not merely one line of light is seen, but several are seen close together,—a sort of ladder with very brilliant rounds, which slowly and regularly ascend between the vertical bars, break off, and then again begin from below." M. Fernet explains these phenomena by referring them to the heating effect of the discharge. "The passage of the spark," he says, "produces in the air a considerable increase of temperature, the air expands and ascends, and thus the upper layer, though longer, offers less resistance than the lower layer, in consequence of which the second spark passes at a higher level than the first spark. The passage of the second spark acts just in the same way upon the third, and so forth, until the discharge takes place at the uppermost points of the bars. The air continues to ascend, but the moment the air between the uppermost points of the bars has become as dense as the air below, the spark betakes itself again to where the distance to be passed through is shortest." That this is the true explanation of the phenomena is proved by placing the bars in a horizontal, instead of in a vertical plane, still keeping them nearer together at one end than at the other. With this arrangement, the spark always passes between those points of the bars which are nearest together. It does the same when the bars are placed vertically, but converging at their upper instead of at their lower ends.

RECLAMATION OF THE ESSEX COAST.

In the early part of the present year, we referred, in an article upon the utilisation of sewage, to the scheme of Messrs. Napier and Hope for intercepting the northern sewage near Barking and Abbey Mills, and conveying it to the sandy coast of Essex, there to do its work of fertilisation. At that time, a bill was about to be presented to Parliament to authorise the carrying out of the scheme, and we then referred to the strong probability that it would be sanctioned. This bill has found its way through both Houses amid good and evil report, and has now become law. Out of it has sprung the "Metropolitan Sewage and Essex Reclamation Company," which is incorporated by special Act of Parliament, and is to have a capital of £2,100,000, in 21,000 scrip certificate shares of £100 each, which are to be divided hereafter into shares of £10 each. The main objects in view are, in the first place, to divert the sewage from the Thames; and, having done this, to render it innocuous by its application to growing crops; and ultimately to realise the greatest money value of the manure contained in it. That these objects can be attained is no mere matter of speculation; the plan of Messrs. Napier and Hope is a well-digested one. Besides, we have the strong evidence of the Craginney Water Meadows before us as in many respects a parallel case. The extraordinary effects of irrigation with town sewage on a sandy soil are here strongly exemplified, and Mr. King's valuable paper on the subject, which appeared in our columns in April last, proves beyond a doubt the practical value of the system. The scheme has been subjected to a searching analysis during the passage of the bill through Parliament, in consequence of strong opposition. But legislative sanction at last stopped all cavil, and set the mark of approbation upon the course pursued by the Metropolitan Board of Works, and showed the utility and practicability of Messrs. Napier and Hope's scheme.

BATTERIES FOR GENERATING ELECTRICITY.

This invention consists of certain improvements in the construction of batteries for the purpose of generating electricity, and in apparatus connected therewith, for the purpose of converting the quantity of electricity so generated into electricity. Letters patent for the same have been granted to Mr. Julius Thomsen, of Denmark, professor of chemistry. The battery consists of a box made from insulating material, and divided by plates of platinum or platinised metal or carbon. The cells between the plates contain sulphuric acid or any other conductive substance dissolved in water. In order to produce the electric current the surface of each plate is charged on one side with oxygen, and on the other side with hydrogen, which is obtained by sending successively an electrical current through each separate cell, by means of which the water is decomposed, and consequently the oxygen is coated or charged on one side of the plate of the cell, and the hydrogen on the side of the plate on the other side of the cell. The apparatus by which this is obtained is the "dispensatory," consisting of a flat ring made from insulating material, on which the same number of radial wires or plates of metal is applied as the battery contains of plates, so that each wire or plate is connected with a corresponding plate in the battery. Through the middle of the ring is placed an axle, which receives a slow rotatory movement by means of an electro-magnetic machine, springwork, or some suitable mechanical motive power. Two conductors are affixed to this axle, which communicate with the two poles of a common galvanic apparatus. The electrical current from the galvanic apparatus is thus sent through that cell the platinum plates of which communicate with the two wires in connection with the poles of the galvanic apparatus, and by which means the water is decomposed into oxygen and hydrogen, which deposits on or charges the platinum plates. By the rotation of the axle the poles of the galvanic apparatus are successively brought into metallic communication with all the plates in the battery, and when the axle has made an entire rotation all the plates are charged. In this state the battery contains the following series of the above-named materials:—Platinum, oxygen, acid, hydrogen, platinum, and so on in the same range, and the battery is equal to the same number of usual galvanic elements. The battery is in this state in working order, and produces a constant electrical current as long as the rotation of the dispensator is kept up. The conversion of the quantity of electricity into intensity is consequently obtained in the following manner and principle—viz., that one single ordinary galvanic element is capable of producing the quantity of electricity which is necessary to charge continuously all the cells of this battery, and that the electro-motive power of this battery depends on the number of cells which the same contains, and which may be increased to any given number, so that the intensity of the current increases in the same ratio as the number of cells, the exact proportion being that the electro-motive power of the battery corresponds for each cell to one and a half of the piles of "Daniell's."

THE FIRST INDUSTRIAL EXHIBITION.

It is generally supposed that the honour of originating the idea of working men's industrial exhibitions is due to the Rev. Newman Hall and Mr. G. M. Murphy, his missionary. It appears that these gentlemen did head the present movement, which is spreading so rapidly, for the formation of these institutions; but it may be interesting to state that so long ago as 1840 there was an exhibition of the same character opened in Glasgow. It was held on the occasion of the tenth annual meeting of the British Association for the Advancement of Science being held in that city. The exhibition principally consisted of models, manufactures, and paintings. A similar exhibition was held in 1846-7, and was open to the public fifteen days. The articles exhibited were classified under six general heads, viz.:—Mechanics and Engineering, Manufactures, Chemistry, Natural History, Works of Art, and Silver Plate, and consisted of over nine hundred separate articles, including nine machines in motion, showing processes of manufacture, above one hundred paintings, and many specimens of sculpture, bronze, and silver. The tickets were sold

at high prices, but 10,000 persons availed themselves of the opportunity and inspected this novel exhibition. For three days the working classes were admitted free, and 54,293 persons passed through the halls. The total receipts amounted to over £1,700, and the balance (£460) has lain idle in one of the Glasgow banks, awaiting the establishment of a similar exhibition, to which it, with the accumulated interest, can only be applied. It is now hoped that this will be speedily done; and an engineer, writing to one of the Glasgow papers, suggests that the exhibition should be a permanent one. From the vast number of industrial members among the population of the city and its suburbs, something worth exhibiting is reasonably expected.—*Building News*.

FLYING MACHINE.

A WORK is now proceeding at Hoboken, N. J., under direction of the Government, which excites attention, from its curiosity as well as scientific interest. It is the construction of a flying machine, which is intended to be independent of the winds for its propulsion. The propelling power is gained by the rapid revolution of large spiral fans, just as a propeller steamship is urged through the water by the screw. The idea is not by any means new, but has many times been proposed; though we do not know that it has been put in practice on a large scale. The working principle is already exhibited in the form of a little toy, simple in construction, and of which there are thousands in use. According to the *New York Army and Navy Journal*, the Government was induced to enter a field which has hitherto been occupied chiefly by enthusiasts, through the representations of the late lamented General O. M. Mitchell. He mounted a fan upon a vertical pole and experimentally determined what size of blades and what speed of revolution were necessary to raise a six-ton load, which is to be the weight of the projected machine. It is canoe-shaped, and built of copper with iron ribs. An engine is placed in the centre, with sufficient power to work a screw fan with twenty foot blades. There are four of these fans connected with the engine—one below, one above the canoe, and one at each end. The upper and lower fans are worked together to produce an ascent, and the terminal fans are made to revolve together or separately in the same direction, or in opposite directions, for the purpose of propelling the craft horizontally. The officer in superintendence hopes to have his task completed in a month.

ATTACHMENT TO STEAM BOILERS.

THE ordinary spring balances or weighted levers, as regulators for the safety valve, are liable to several objections, which arise from the nature of the spring and the lever as applied to them. The spring balance is too slow to act in case of any sudden or undue generation of steam in the boiler, and consequently always requires the watchful eye of the engineer, in such cases requiring both tripping by the hand and often a lessening of its tension. Should the engineer be called away it will allow an escape of steam long after the pressure has come down to its nominal standard. This is both dangerous and annoying. The machine shown in the accompanying engraving has been patented in America by Mr. Peter Riordan, of Washington, and combines in itself the steam gauge, water indicator, safety valve regulator, alarm, and blow-off, and is designed to fill the place of these appendages. This machine not only entirely overcomes these difficulties as a safety valve regulator, but is also a superior pressure gauge that will indicate the varying pressure of steam from one pound up to what the regulator is set at, beyond which the pressure cannot get. It is also an accurate and delicate water indicator, showing the varying heights at which the water stands in the boiler. Should the water, through neglect, get very low, it will sound an alarm whistle that cannot fail to attract the engineer's attention. Should the alarm be neglected and the water fall to a dangerously low level it will then allow the steam to escape through the safety valve at a very rapid rate, so as to reduce its elastic force immediately, and thus insure the safety of the boiler. The following description, which, with an illustration appears in a recent number of the *Scientific American*, will render this device intelligible. It consists of a cylinder A, fitted with the piston heads B B' working steam-tight in the cylinder and made fast with the rod C, which works through the stuffing-box on the top

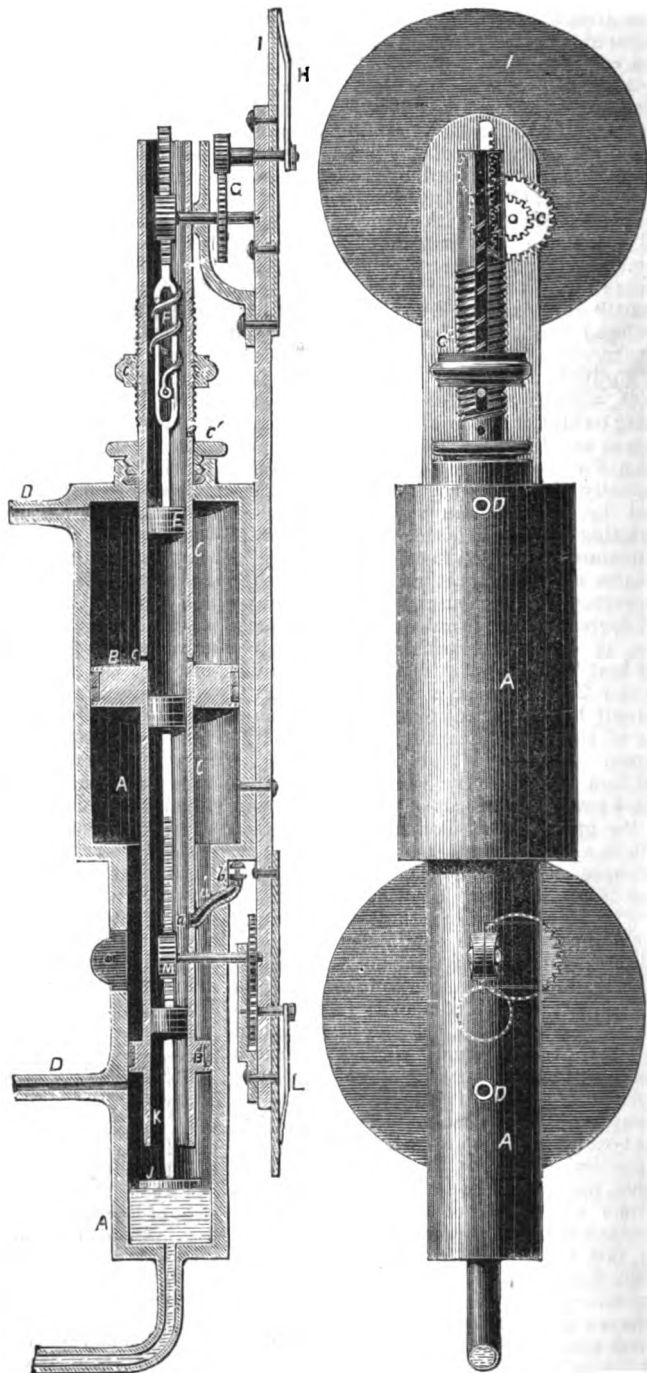
of the cylinder. Steam is admitted through the apertures D D from the boiler, and the area of the head B is greater than that of B' by as much as the area of the safety valve lessened by the amount of the long arm of the safety valve lever is greater than the short, and the rod C is made fast at the top to this lever. This is after making due allowance for the weight operating on the end of the lever of such parts of the regulator as have a gravitating effect on it. The rod C is hollow throughout, and is perforated by the apertures c c c', and is fitted with the collar C', which can be operated as a hand screw. The valve E is made fast on to the small rod e, and works steam-tight in the hollow rod C. One end of the spiral spring F is made fast to the collar C', and the other to the rod e. The upper end of this rod constitutes a rack which operates suitable gear wheels G, that turn the hand H upon the face of the dial I. When steam is generated in the boiler, and enters by the apertures D D, it presses downward on the head B, and contrariwise on the head B'. Now, if the total lifting power of the safety valve, at the end of its lever be, say 30 lbs., when the pressure in the boiler is 50 lbs. on the square inch, and if the weight of any parts of the regulator acting by gravity on the lever be 5 lbs. and if the total effective area of the head B be two square inches, that of the head B' must be 1½ in. The total pressure on the upper head will be 100 lbs., and on the lever 75 lbs., so as to exactly counterbalance the lifting power at the end of the safety valve lever. The collar C' is screwed down on the rod C, which has a graduated face for its regulation, so far as to prevent the valve E (on the under side of which the steam is acting, having free access through the apertures c c) from overcoming the power of the spring F, and clearing the aperture c' c', until the steam has got up to 51 lbs., when the valve will rise above the apertures c' c', and steam from above the head B will escape into the air. This will prevent the total pressure on the head B from exceeding 100 lbs., while that on the head B' becomes 76½ lbs., which has an effect on the safety valve the same as if the ordinary spring balance were suddenly reduced in tension by 2 lbs., and so on for every 1 lb. increase of pressure on the boiler, this regulator allowing an accelerating escape of steam through the safety valve. This action is exactly reversed as the steam comes down to its normal pressure. It is easy to see that as the pressure in the boiler varies, the valve E, acting under the control of the spring F, will be moving up or down, thus acting through the gear wheels G G on the index hand H.

The cylinder A is fixed on the boiler so that when the water stands at the proper height in the boiler it will stand at a certain height in the lower part of the cylinder A. In this is fitted the float J, made fast on the rod K, and having a rack on it acting on the index L, through the gearing M M; and the rod K is provided with

ATTACHMENT TO STEAM BOILERS.

FIG. 1

FIG. 2



stuffings or packing N N'. Now, when the water stands at the proper height in the boiler, the stuffings N N' will prevent any escape of steam, but when the water gets low the float, bringing down the rod and stuffings, on the upper one N' coming below the aperture a, steam will escape through the flexible pipe a, and sound the alarm whistle b. Should this not be noticed, on its coming further down, there being slots in the hollow shaft, steam will escape into the air. This steam, coming from above the piston head B, will have the same effect on the safety-valve as if the collar C' were set to control a smaller pressure and that the escape were through the apertures c' c'. This arrangement may appear a little difficult to comprehend at first sight, as the principle of the regulator is entirely novel, but everything is simple in construction, and the whole arrangement will not be liable to get out of order, and cannot but prove extremely useful. It is designed on scientific principles, and will be found to perform all that is claimed for it in the most reliable manner. It will relieve the engineer from incessant watching of innumerable gauges, cocks, tubes, and balances, which is done much to the detriment of other parts of the machinery under his care, which often suffers for the want of supervision.

MAGNETICAL DIP INSTRUMENTS.

In his last annual report to the Board of Visitors of the Greenwich Observatory, the Astronomer-Royal observes that the history of the Dip-Instrument during the year just elapsed is important, and states the following facts:—"In discussing all the observations made since the introduction of the new instrument I found it totally impossible to infer from them the value of the zenith-point (or reading of the circle when the dipping-needle is vertical). The instrument is adapted to needles of three different lengths (3, 6, 9 in.) and the difficulty was felt equally with all. It then appeared to me that we had been proceeding in a course philosophically wrong, in attempting to infer the value of a purely geometrical element from observations so foreign in their nature and so defective in their accuracy as magnetical dips, when an independent and accurate determination might with ease be obtained. I therefore directed Mr. Simms to construct a zenith-point-needle of brass; with pivots similar to those of the dip-needles; and with three pairs of points corresponding to the three lengths of needles used; loaded at one end so as to take a position perfectly definite with respect to the direction of gravity; to be observed with the microscopes, and to be reversed, exactly as the dip-needles. I consider this small apparatus to be a valuable adjunct to the dip instrument, as giving the means of deducing independently a separate result from every one of the observations made in the several positions of the needle.

"In many successive years I have adverted with great anxiety to the difficulties which I have experienced in the determination of magnetical dips, and in my last report I expressed my inability to receive as certain the reputed accordance of dip-determinations obtained in other places. To this I was led partly by the irregularities of our dip-results, of which after the severest examination I could find no direct explanation; and by the difficulties which, as I knew, had troubled other observers: but mainly by finding that needles of different forms produced systematic differences in the magnitude of the discordances which were produced by simply raising and lowering the needles. In the course of the last autumn, the committee of the Kew Observatory courteously acceded to my request that two of their dip-instruments should be placed for a time at the Royal Observatory, in order that Mr. Glaisher, in concert with Mr. Balfour Stewart (Directors of the Kew Observatory), might make observations with them. The dips were found to be accordant to a degree which I never witnessed before. Without having yet strictly brought the results to numerical comparison, I have now no doubt that they do bear a consistency equal to or comparable to that which is claimed for them; and I recognise that I was misled by the reasons, strong as I still consider them to be, which I adduced in my last report. It happened that Mr. Simms, by whom our instruments now in use were prepared, and who had personally witnessed our former difficulties, was present during some of these experiments. Our own instrument being placed in his hands (November 10th to 19th) for another purpose, he spontaneously re-polished the apparently faultless agate-bearings. To my great astonishment, the inconsistencies of every kind have nearly or entirely vanished. On raising and lowering the needles, they return to the same readings, and the dips with the same needle appear generally consistent.

"No care had been spared to make our agate-edges perfect. Those of the old instrument were prepared by Mr. Robinson and were revised by Mr. Barrow. Those of the new instrument were made by Mr. Simms. In using the services of the three confessedly best artists of Britain, I thought myself secure as to the character of the workmanship which I should obtain; and indeed I know not what else could have been done. As the greatest enemy to success in instrumental construction is secrecy on the manipulation adopted, I will here give all the information that has reached me on the methods actually employed. On a very close examination of Robinson's agates, Mr. Simms sees concavities (which, as I believe, I also see myself), suggesting to him the idea that, after being shaped (perhaps by some inefficient process) with coarse emery, the surfaces were immediately polished with tin-oxide or other polishing powder carried by a cloth. Mr. Simms' first agate-edges, after

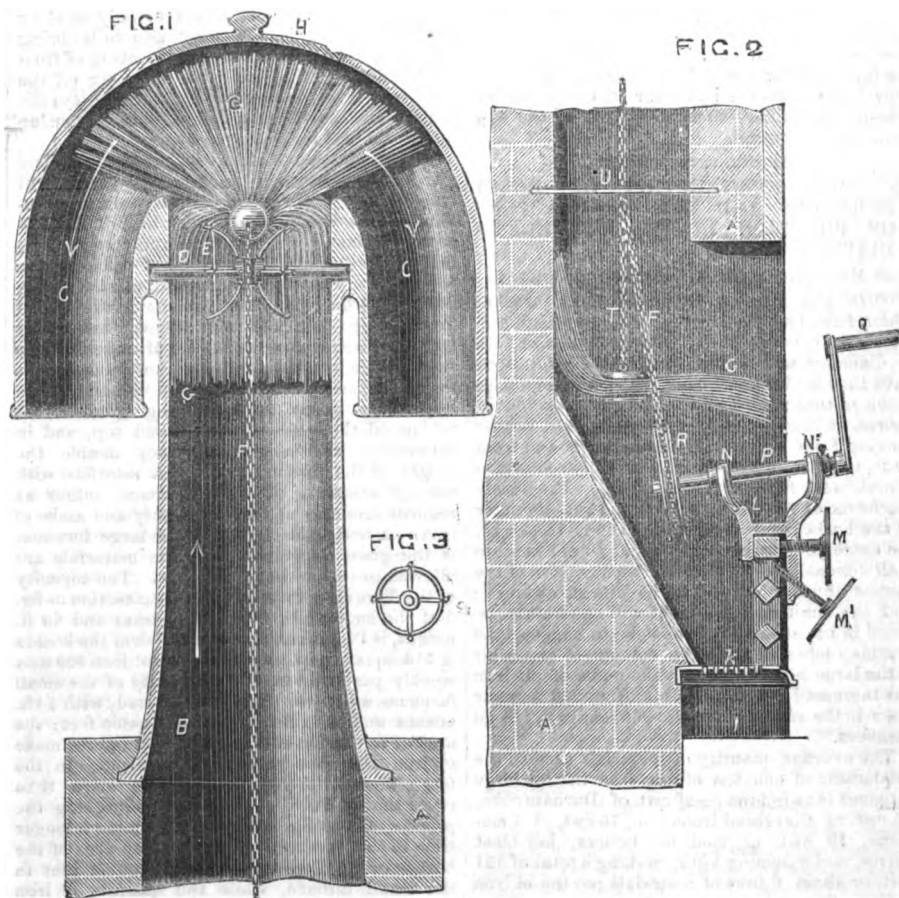
being roughly shaped, were brought to form with coarse emery, then ground with fine emery, and then polished with rotten-stone powder, all carried by the same leaden tool; the form of the tool admitted of cross-stroke, and it is believed that the only fault in the process was that the cross-stroke was used too freely. The same agate-edges were brought to their present state by the use successively of fine emery and tin-oxide, carried by a brass tool which nearly fitted the agates, and which scarcely permitted cross-strokes; and the strokes were almost entirely longitudinal. I am still unable to see how this change of treatment can account for the removal of the discordances formerly observed, and I regard these discordances as authentic facts of observation, the study of which may not improbably lead to important conclusions on the nature of magnetisation, and the nature of pivot-bearing."

CHIMNEY TOPS AND VENTILATORS.

THIS invention has for its object certain improvements applicable to chimney tops or cowls and ventilators, and apparatus for cleaning or sweeping the same and flues generally, which improvements have been patented by Mr. Hugh Dyer, of Liverpool. In the annexed engraving fig. 1 is a vertical sectional elevation of an improved chimney top or ventilator, showing a skeleton pulley with a circular brush passing over it; fig. 2 is a vertical sectional elevation of a fireplace, showing the forked bearings carrying the transverse shaft, on the inner end of which is keyed a grooved pulley, over which passes an endless chain or wire rope for operating the travelling brush, the standards for carrying the revolving shaft are attached to the bars of the grate by means of set screws. A, is the brick-work; B, the vertical shaft of the improved chimney top or ventilator, which is capped by C, the top, which consists of two curved

of the grate by means of M and M', set screws N and N', two forked arms on the clamp L, which carry the bearings for P, a driving shaft, the outer end of which is fitted with Q a crank handle for revolving the shaft, which shaft is also fitted on its inner end with R, a grooved pulley, over which travels the endless chain or band F, to which is suspended the travelling brush G by means of T, a short chain or cord. U is a stationary transverse bar placed in the throat or take-up of the flue, separating the folds of the endless band to prevent the same becoming twisted together and thereby foul when the apparatus is not in use, and over which the lower portion is thrown when not in use. A vertical frame is arranged so as to be expanded or contracted to cover the fireplace openings of various sizes, the same being covered with a screen of cloth or other suitable material, and is jointed at the bottom on to a horizontal frame resting on the floor in such a way that when not in use the same may be folded up to a convenient size.

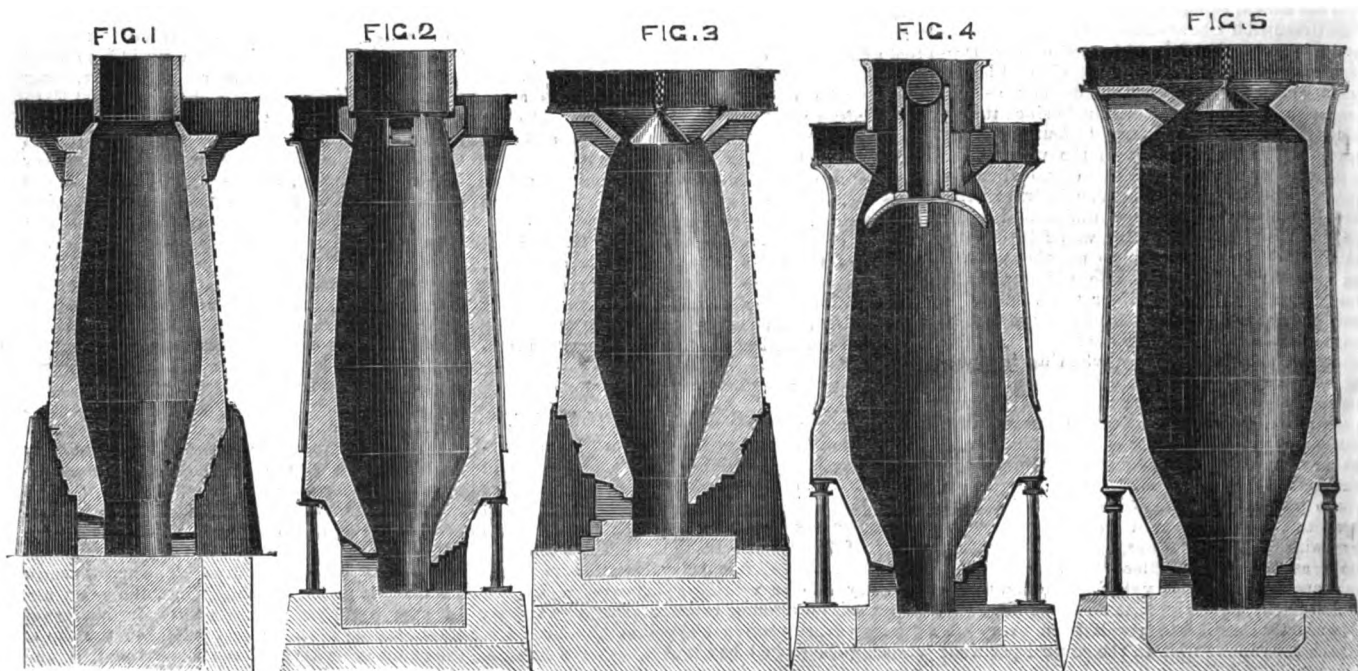
When this improved apparatus is used simply as a ventilator on the head of an air shaft the brushing apparatus may be dispensed with, and when used as a chimney top the brushing apparatus may also be dispensed with, but in the latter case the inventor prefers to connect thereto the sweeping apparatus. The arrows show the direction of the draught into the open air. In applying this apparatus to air shafts or chimneys the inventor first builds on the top of the chimney or air shaft the vertical shaft B, and if an air shaft, in most cases he simply places on the top of the vertical shaft the top with the curved pendent branch arms and its lid; the lid is fixed in the top, when it is complete, but when the brushing apparatus is used in conjunction therewith, an endless band of chain, wire rope, or other suitable material of the required length, is passed down the chimney or air shaft; the upper portion is then placed over the open-sided



pendent branch arms, which at the bottom open out into the atmosphere; D is a transverse shaft which forms the axle of E, an open-sided grooved pulley, a side elevation of which is shown at fig. 3, and over which travels F, the endless band of chain, wire rope, or other suitable material, and G, the travelling brush. H is a tight-fitting lid fitted in the top of the chimney top or ventilator for the convenience of getting at the open-sided pulley E and its transverse shaft D; I, bottom of the grate; K, bars of the grate; L, a clamp which is attached to the bars

grooved pulley, and the same placed with it shaft in position in the chimney or ventilator top. The rigid bar is then placed in the throat or take-up of the flue or chimney, so as to pass between the folds of the endless band. When it is desired to clean the flue, the clamp and its appendages, as illustrated in fig. 2, are placed in position in front of the fireplace or lower opening of the air flue, care being taken to pass the endless band over the grooved pulley on the inner end of the horizontal or oblique shaft. The brush is then attached to the endless band by means of a short

BLAST FURNACES FOR THE MANUFACTURE OF PIG IRON.



pendent chain or cord; the shaft is then rotated by means of the crank handle, which draws the travelling brush up the flue and over the open-sided grooved pulley in the improved ventilator or chimney top. By continuing to turn the crank handle in the same direction, the brush descends and this operation is repeated as often as may be deemed necessary, so as to entirely remove the soot or dust adhering to the sides of the flue. The clamp or frame with its appurtenances is then removed from the grate or lower opening in the air flue, the brush removed and the lower end of the chain or endless band hung over the transverse rigid bar in the throat or take-up of the flue, so as to be out of the way until again required.

ON THE CONSTRUCTION OF BLAST FURNACES AND THE MANUFACTURE OF PIG IRON IN THE CLEVELAND DISTRICT.*

By MR. JAMES GEORGE BECKTON, OF WHITBY.

WITHIN the last ten years the blast furnaces which have been erected in the Cleveland district have been gradually increased in size both in diameter and height; and these alterations have thus far been attended with good results, so much so that almost all the new furnaces now in course of erection are being built with boshes ranging from 16 ft. to 22½ ft. diameter, and from 60 ft. to 75 ft. in height from the bottom of the hearth to the filling plates at the top. Previously the furnaces ranged from 13 ft. to 15 ft. diameter at the boshes and from 45 ft. to 50 ft. in height, the extreme increase being about 70 per cent. in both dimensions. The maximum diameter of the boshes appears not yet to have been attained; and the limit to the height will apparently be found in the strength of the coke to support the crushing force of the high column of materials in the large blast furnace. The make of pig iron has increased at the same time from 200 tons per week in the small furnaces to 300 tons in the large furnaces.

The average quantity of materials used in the production of one ton of pig iron in the large furnaces is as follows:—26 cwt. of Durham coke, 70 cwt. of Cleveland ironstone, 15 cwt. of limestone, 10 cwt. of coal for boilers, hot-blast stoves, and calcining kilns, making a total of 121 cwt. or about 6 tons of materials per ton of iron made. Formerly the quantity of coke used per ton of iron made averaged 35 cwt. instead of 26 cwt., and the quantity of coal 20 cwt. instead of 10 cwt. The writer does not attribute the whole of the saving of fuel which has taken place to the increased size of the furnaces alone, as there are several other improvements which have combined to produce an economy of fuel in the manufacture of pig iron in the Cleveland district, of which the following are some of the principal:—First, the more efficient management

which has taken place at the different works. Second, the better adaptation of engine power and hot-blast stoves to the requirements of the furnaces. Third, the improved system of calcining the ore, which was formerly carried on by clamping in the open air, but is now performed in properly constructed calcining kilns. Fourth, the higher degree of temperature of the blast supplied to the furnaces, which was formerly heated in the hot-blast stoves to only 600° or 700° Fahr., but is now very generally being supplied to the furnaces at a temperature of from 800° to 900°. Fifth, the plan of taking off the waste gas from the furnaces and burning it at the boilers and hot-blast stoves, in place of using additional coal for this purpose.

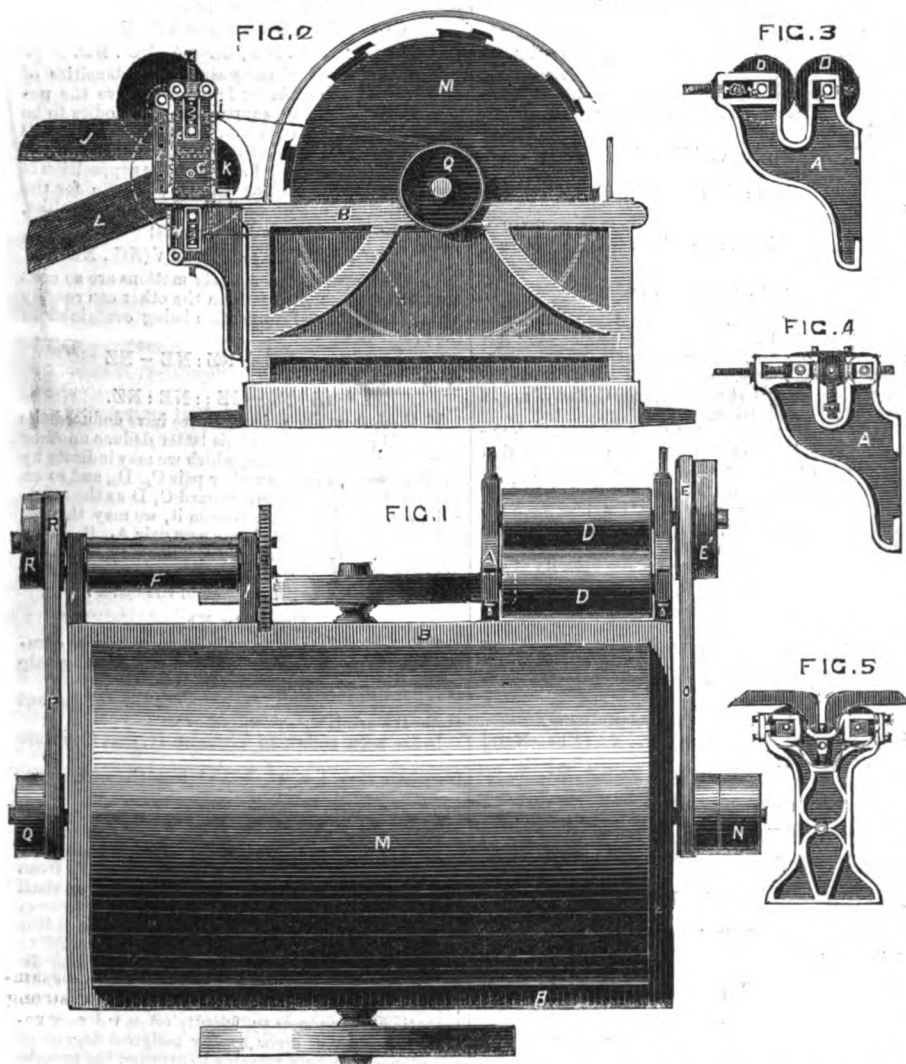
The application of the waste gas to the boilers and hot-blast stoves is becoming very general at the different works in the district; and arrangements are now being made at several of the new works in course of erection for applying it to the calcining kilns, for the purpose of calcining the ironstone. The plan in general use for taking off the gas from the blast furnace is the closed furnace top with bell and hopper sufficiently large to charge from 8 to 10 tons of materials into the furnace at once, and with an arrangement for raising and lowering the bell by hand. The impression seems to be gaining ground that taking off the gas with the closed top, and in connection with a large chimney double the height of the furnaces, does not interfere with the operations of the large furnace, either as regards economy of fuel or quality and make of iron. A noticeable feature in the large furnaces is the great amount of time the materials are allowed to remain in the furnace. The capacity of the Thornaby furnaces, shown in section in fig. 4 of the engraving, with 20 ft. boshes and 60 ft. height, is 12,361 cubic feet; the area of the boshes is 314 square feet, and the make of iron 800 tons weekly per furnace. The capacity of the small furnaces which were formerly erected, with 14 ft. boshes and 50 ft. height, is 5,558 cubic feet; the area of the boshes is 154 square feet, and the make of iron 200 tons weekly per furnace. In the large furnace therefore there are more than twice the quantity of materials undergoing the process of heating, and also remaining a longer time in the furnace. Moreover the area of the boshes in the large furnace being double that in the small furnace, while the quantity of iron produced by the large furnace and consequently the quantity of blast supplied is only one and a half times as much as in the small furnace, it follows that the ascending gases pass through the materials at a slower velocity and at a lower temperature in the large furnace. This allows the coke to descend to the zone of fusion without losing so much of its carbon in the formation of carbonic oxide as previously in the small furnace; and hence arises the greater economy of fuel in the large furnace. To produce 300 tons of pig iron per week, the large furnace requires to be supplied with 8,000 cubic feet of blast

per minute at a pressure of 3 lbs. per square inch.

Fig. 1 in the engraving is a vertical section of one of four furnaces at the Ormesby Ironworks, Middlesbrough, belonging to Messrs. Cochrane. These furnaces were erected in 1855, and were the largest in the district at that time; the boshes are 16 ft. diameter and the height is 56½ ft. The furnaces are constructed upon land consisting of mud and silt, and piling had therefore to be resorted to in order to secure a good foundation for the furnaces. A bed of concrete was placed on the top of the piles, and six inverted arches were turned on the top of the concrete, and the brick pillars carried up, and strong cast-iron bearers fixed across the top for carrying and binding the brickwork of the barrel and boshes. The outer shell is bound with wrought iron hoops, fixed near enough together to prevent the barrel from cracking. The boshes are at an angle of 75° from the horizontal. Fig. 2 is a vertical section of one of four furnaces erected in 1858 at the Jarrow Ironworks, Newcastle-on-Tyne. There was a good strong clay for the foundations of the furnaces to rest upon; the brickwork was carried up to the floorline, then twelve cast-iron columns were erected, and wrought iron casings fixed on the top of these. The casings extend from the top of the five tuyere houses to the top of the boshes, above which the barrel is bound with wrought-iron hoops supported by T irons, the latter being carried up to the top, and a flat ring riveted to them sufficiently strong to carry the floor-plates. The boshes are 18 ft. diameter, at an angle of 66° from the horizontal, and the furnaces are 60 ft. high. Fig. 3 is a vertical section of one of three furnaces at the Normanby Ironworks, Middlesbrough, belonging to Messrs. Jones, Dunning, and Co. These furnaces were erected in 1860, and are constructed upon a bed of concrete, on clay of a weak nature; they are supported on brick pillars and hooped similarly to the Ormesby furnaces. The boshes are 18 ft. diameter, at an angle of 72° from the horizontal, and the furnaces are 58 ft. high. Fig. 4 is a vertical section of one of three furnaces erected in 1863 at the Thornaby Ironworks, South Stockton-on-Tees, belonging to Messrs. Whitwell. These furnaces are constructed upon piles, in consequence of the land being mud and silt; they stand each upon twelve cast-iron columns, and are cased with iron similarly to the Jarrow furnaces. The boshes are 20 ft. diameter, at an angle of 68° from the horizontal, and the furnaces are 60 ft. high. Fig. 5 is a vertical section of one of three furnaces which are being erected at the Acklam Ironworks, Middlesbrough, by Messrs. Stevenson, Wilson, Jaques, and Co. They are being built on piles, in consequence of the land being mud and silt, and are each supported by twelve cast-iron pillars. The brickwork around the boshes is cased with plates, and from the boshes up to the top the barrel is bound with hoops and T irons. The boshes are 22½ ft.

* Read before the Institution of Mechanical Engineers, August 3, 1864.

MACHINES FOR SEEDING AND BREAKING FLAX.



diameter, at an angle of 68° from the horizontal, and the furnaces are 70 ft. high. These furnaces the writer believes to be the largest in dimensions that have ever been erected, and their contents will amount to no less than 1,250 tons of materials per furnace. They are expected to produce each 350 tons of pig iron per week.

MACHINES FOR SEEDING AND BREAKING FLAX.

MR. GEORGE PARSONS, of Martock, Somerset, engineer, has patented an invention which consists in constructing machines for seeding and for breaking flax as hereafter described. For seeding flax he employs a pair of rollers kept up in their bearings by springs or levers; then for the purpose of breaking flax he substitutes for these rollers three fluted rollers. Another arrangement of breaking machines consists in the employment of three rollers superposed, in order that the flax fed at one side of the machine may also come out from the same side; or this exit of the flax is accomplished at the same side of the machine as that at which it entered, whereby one attendant is saved, by the employment of two rollers, to the back of which is fitted or placed a shield or guide, which directs back the straw under the lower roller, and returns it to the same side of the machine as that at which it entered. This invention also consists in combining one of these flax seeding or breaking machines with a scutching machine, so that only one belt from the prime mover will suffice to drive both machines. For this purpose the rollers of the flax seeding or breaking machine are mounted in bearings fixed to the upper part of the frame which carries the scutching machine. The belt from the prime mover drives the scutching machine, while a belt or strap passing from a pulley on the shaft of the scutching machine to another pulley on the shaft of the flax seeding or breaking machine transmits the motion to the latter; or the belt from the prime mover may be caused to drive the flax seeding or breaking machine direct, the

scutching machine receiving motion from the shaft of the seeding or breaking machine in the manner just explained.

In the accompanying engraving fig. 1 is a plan, and fig. 2 an end elevation showing a flax seeding machine, a breaking machine, and a scutching machine all combined in one frame; fig. 3 is a side elevation of the seeding machine. A A are brackets fixed to the frame B, and formed with bearings C C for carrying a pair of seeding rollers D D; these rollers are kept up in their bearings by springs $\alpha \alpha$ as shown, or they may be kept up in their bearings by levers. The rollers D D are driven in the ordinary manner by a belt passing round the pulley E. If required the seeding rollers D D may be removed and replaced by three fluted breaking rollers, two of which are placed in the same bearings as the rollers D D and the other in a separate bearing inserted into the framing, as shown at fig. 4 and at fig. 5. On the same side of the frame B as the seeding rollers D D, a breaking machine is placed, consisting of three superposed rollers F G H, supported in bearings I I. The flax is fed in from a table J, between the two upper rollers F G, and after having passed through these rollers is guided by a curved plate K between the rollers G H, so that it comes out upon another table L immediately below the table J. In some cases the lowest roller H may be dispensed with, and the guide K extended further towards the front of the machine to cause the delivery of the flax at the same side of the machine as that at which it was fed in. M is the scutching machine mounted in the same frame B, which supports the flax seeding and breaking machines in such manner that one belt from the prime mover will suffice to drive all the machines. The belt from the prime mover passes round a pulley N on one end of the shaft of the scutching machine, and the motion is transmitted to the seeding machine by a belt O passing from the pulley N to the pulley E. When the seeding machine is not in work the belt O is moved on to a loose pulley E'. The breaking machine is driven by a belt P, passing over

another pulley Q on the other end of the scutching machine shaft, and over a pulley R on the breaking machine; the breaking machine is also provided with a loose pulley R'. For convenience of carriage the frame B is provided with axles and wheels to admit of the machine being moved from place to place. Instead of being driven by belts, as just described, the seeding and breaking machines may receive their motion from the shaft of the scutching machine by toothed gearing, or, as before stated, the motion from the prime mover may be first imparted to the seeding or the breaking machine and transmitted to the other machines by belts or toothed gearing.

PSEUDOSCOPIC VISION.

By J. B. DANCER, F.R.A.S.

AT a late meeting of the Literary and Philosophical Society the following paper on "Pseudoscopic Vision through Prisms" was read:—If we look with both eyes at an object, such as the flat top of a table for example, and then interpose a prism between one eye and the object, we discover, after a short time, that the portion of the surface to which the sight is particularly directed has apparently changed its distance. If, in trying the experiment, the thin edge of the prism is turned towards the nose, the flat surface will appear concave; if, on the contrary, the base or thick edge is turned towards the nose, the surface will appear convex. The full effect of this alteration in the appearance of the object is not realised immediately. Some persons see it perfectly in a few seconds, others require some moments of steady gazing before it becomes evident to them. The character of the surface to which the vision is directed exercises some influence in producing the effect. A circular table covered with a cloth of a bright pattern, having a few articles disposed towards the edges, exhibits this fallacious vision in a marked degree. The angle of the prisms for showing these experiments should be about 15° ; if less than this, the elevation or depression of surface is not sufficient to produce a good effect; if the angle is much greater than 15° , many persons are unable to unite the refracted image of the prism with the real image seen by the other eye. Achromatic prisms are much to be preferred in these experiments to those which are uncorrected for colour. Experiments with these prisms have shown that the power of converging the optic axes differs very considerably in individuals.

Oculists occasionally recommend prismatic lenses mounted in spectacles to assist persons who suffer from insufficiency of the recti interni muscles; it would be interesting to know if those so assisted have noticed the fallacious appearances which the healthy eye can appreciate. The pseudoscopic effects are exaggerated by using a prism to each eye, but in most persons this produces a painful sensation. The explanation of these phenomena, which I offer with some hesitation, is based upon the supposition that in binocular vision we estimate the distance of an object by the degree of convergence of the optic axes. In these experiments, when a flat surface appears concave by the interposition of the prism, the optic axes are made to converge on a point situated behind the real surface, and the imagination gradually removes the object to this apparent distance. When the base of the prism is towards the nose, then the flat surface becomes convex; in this case the optic axes cross in front of the real surface, and the imagination raises the object to that point. A diagram of the convergence of the optic axes on an object, before and after the interposition of the prism, will show that when the thin edge of the prism is turned towards the nose, the effort made to unite the real and the refracted image is the same as if the vision was directed to a point more distant than the real object. The opposite to this takes place when the base of the prism is turned towards the nose. It is very possible that the pseudoscopic vision through prisms may have been noticed by others, but I have not been able to discover any description of such in the works to which I have access.

Brescius states in *Dingler's Polytech. Journal* that gold may be easily obtained in a convenient form for gilding by precipitation in the cold from an alkaline solution by means of oxalic acid. He dissolves four ounces of gold in a mixture of two pounds nitric acid (s.p. gr. 1.2) and one pound hydrochloric acid (s.p. gr. 1.12). To this solution he adds another, made by dissolving pure potash, or, at all events, potash free from silica, in five or six parts of distilled water. After filtration, this latter solution is gradually added to the gold solution. The mixture is now diluted with eight pounds of distilled water and then a clear and cold solution of one-third of a pound of oxalic acid is stirred in, care being taken not to rub the sides of the dish with the rod. In this way a bulky, spongy, black precipitate is obtained, which must be allowed to settle, and then be well washed and dried.

MOTION IN A CIRCLE.

BY EDWARD SANG, ESQ.

(Continued from page 10.)

THEOREM IV.

If a third body C move so as to be continually in the middle of the arc $\alpha\beta$ intercepted between the positions of the two conjugate bodies A and B, the motion of C is such as is due to the influence of gravitation of some determinable intensity.

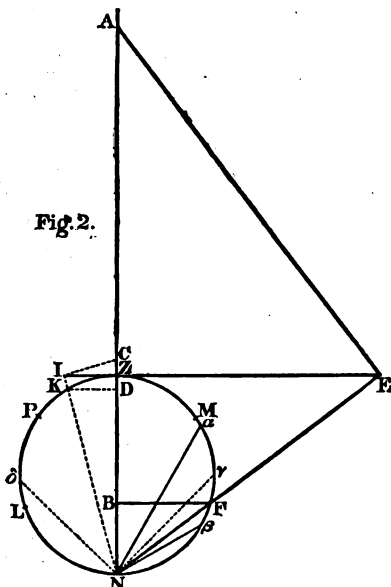


Fig. 2.

Having bisected the arc $\alpha\beta$ in γ , let us study the motions of the three points $\alpha\beta\gamma$, that is, of the three moving bodies A B C. At the outset, all three proceed from N in the same direction, the velocity of C, being at all times the arithmetical mean between the velocities of A and B. When A has reached the zenith point Z, and B its highest point F, the body C must be at M, the middle of the arc FZ; and, since the velocity of B at F is zero, that of C at M must be half of the velocity of A at Z. Thereafter, while A descends from Z along the semicircumference Z L N, B descends along the arc F N, and as the motions are now in opposite directions along the circumference, the velocity of C must be half the difference of the actual velocities, that is, half their sum taken with the algebraic signs; and at the instant when A and B have met at N with their initial velocities, but now in opposite directions, C must be found at Z moving onwards with a velocity equal to half the difference of the initial velocities of A and B. The motions still continuing, A rises along the arc N F Z, while B ascends to L, and then C has moved along the arc D P, P being the middle of DL, the velocity which C has at P being half of that which A has when at Z. While A and B now descend from Z and L respectively, their motions are in the same direction, and C descends from P, so that all three reach N at the same instant, the velocity of C being now half the sum of the velocities of A and B. The same phases will now be repeated.

It is thus seen that the intermediate body C completes its revolution when the body A has made two revolutions, that is, when B has made a complete oscillation. When C is at N its velocity is half the sum, when at Z half the difference, of the initial velocities of A and B, and at intermediate points its velocity is intermediate between those two extremes, so that its motion partakes of the general character of circular motion influenced by gravitation; and it remains to be shown that it possesses that character in all respects.

Since the square of the velocity which a body acquires in falling is proportional to the intensity of gravitation, and to the distance jointly, it follows that the squares of the initial velocities of A and B are proportional to the rectangles NZ . NA and NA . NB; wherefore putting V_A and V_B for those initial velocities,

$$V_A : V_B :: NE : NZ.$$

If then, NC be the distance from which the body C may be supposed to have descended in order to acquire the actual velocity at N, its velocity at Z must be that which is due to a descent through CZ. Now the velocities of the intermediate body C when at N and Z are in the ratio of $V_A + V_B$ to $V_A - V_B$, that is of $NE + NZ$ to $NE - NZ$; wherefore, since the squares of those velocities are in the ratio of CN to CZ, we must have the proportion

CN : CZ :: $(NE + NZ)^2 : (NE - NZ)^2$, by help of which the position of the point C may be determined. Observing that $CN - CZ = NZ$ we obtain

$$CN = \frac{(NE + NZ)^2}{4NE} = \frac{(NZ + NF)^2}{4NF},$$

and

$$CZ = \frac{(NE - NZ)^2}{4NE} = \frac{(NZ - NF)^2}{4NF}.$$

The intensity of the gravitation which must act upon C in order that it may have at N and at Z the above velocities, may be discovered by observing that if G_C represent the required intensity, we must have

$$V_A : V_C :: \sqrt{G_A \cdot AN} : \sqrt{G_C \cdot CN};$$

but

$$V_A : V_C :: NE : \frac{1}{2}(NE + NZ),$$

wherefore

$$NE^2 : \frac{1}{4}(NE + NZ)^2 :: G_A \cdot AN : G_C \cdot \frac{(NE + NZ)^2}{4NE},$$

that is

$$NE : AN :: G_A : G_C.$$

Now the intensity of the gravitation acting on A was proportional to NZ, wherefore since $NZ : AN :: NZ : NE$, that acting on C must be proportional to NE; that is to say, the intensities of the gravitation acting on the three bodies A, C, and B are in geometrical progression.

We have now to show that the velocity which the intermediate body C has at any point γ is that which is due to the action of this gravitation.

For this purpose let EZ be continued to I, so that ZI may be a mean proportional between ZC and ZN, and join NI, then NI is a mean proportional between NZ and NC. It has been shown (Theorem I.) that the square of the velocity at α is proportional to $NE^2 - Na^2$, so that, G_A being the intensity of gravitation for the body A, we may put

$$v_\alpha = \sqrt{G_A(NE^2 - Na^2)} = \sqrt{NZ \cdot NZ(NE^2 - Na^2)} = \sqrt{NE \cdot NE(NZ^2 - Na^2)} = NE \cdot Z\beta,$$

while

$$v_\beta = \sqrt{G_B(NF^2 - N\beta^2)} = \sqrt{NZ \cdot NA(NF^2 - N\beta^2)} = \sqrt{NZ \cdot NZ(NZ^2 - N\alpha^2)} = NZ \cdot Z\alpha$$

and in the very same way it may be shown that

$$v_\gamma = \sqrt{G_C(NI^2 - N\gamma^2)} = \sqrt{NE \cdot NZ(NI^2 - N\gamma^2)}$$

But, because γ is the middle of the arc $\alpha\beta$,

$$N\gamma^2 = \frac{1}{4}\{NZ^2 + Na^2 \cdot N\beta^2 - Z\alpha \cdot Z\beta\}$$

while

$$NI^2 = NZ \cdot NC = \frac{NZ^2 \cdot NE^2 + 2NZ^2 \cdot NE + NZ^2}{4NZ \cdot NE},$$

so that

$$NI^2 - N\gamma^2 = \frac{NZ^2 \cdot NE^2 + NZ^2 - 2NE \cdot NZ \cdot Na}{4NZ \cdot NE}$$

$$N\beta + 2NE \cdot NZ \cdot Z\alpha \cdot Z\beta;$$

now $NE \cdot N\beta = NZ \cdot Na$, wherefore the continued product $NE \cdot NZ \cdot Na \cdot N\beta$ may be written either $NE^2 \cdot N\beta^2$ or $NZ^2 \cdot Na^2$. Writing it once each way we obtain

$$NI^2 - Na^2 = \frac{NE^2(NZ^2 - N\beta^2) + NZ^2(NZ^2 - Na^2)}{4 \cdot NZ \cdot NE}$$

$$+ \frac{2NE \cdot NZ \cdot Z\alpha \cdot Z\beta}{4NZ \cdot NE} = \frac{NE^2 \cdot Z\beta^2 + NZ^2 \cdot Z\alpha^2 + 2NE \cdot NZ \cdot Z\alpha \cdot Z\beta}{4NZ \cdot NE} = \frac{(NE \cdot Z\beta + NZ \cdot Z\alpha)^2}{4NZ \cdot NE}$$

Inserting this in the expression for v_γ we have

$$v_\gamma = \frac{1}{2}(NE \cdot Z\beta + NZ \cdot Z\alpha) = \frac{1}{2}(v_\alpha + v_\beta);$$

so that the velocity at γ of a body which, acted on by a gravitation proportional to NZ . NE, has descended from the level of C, is just the arithmetical mean of the velocities of the two bodies A and B, the one influenced by gravitation proportional to NZ . NZ, the other by one proportional to NZ . NA

THEOREM V.

From one pair of conjugate motions an endless series of pairs may be obtained, having their periodic times in determinate ratios.

Let NI cut the circumference at K and draw KD horizontally; then if a fourth body D be acted on by gravitation having its intensity a fourth proportional to NZ, NC and the intensity of the gravitation acting on O and set out from N with a velocity due to its descent from the level of D, its motion will be conjugate with that of C; and if we infect N δ such that NC : NZ or NZ : NK :: N γ : N δ , the body D will ascend from N to δ in the same time that C ascends from N to γ .

In this way we have two pairs of conjugate motions, the periodic time of the second pair being double of that of the first, and the intensities of gravitation being

$$\begin{aligned} G_A &= NZ \cdot NZ \\ G_B &= NZ \cdot NA \\ G_C &= NZ \cdot NE \\ G_D &= NC \cdot NE \end{aligned}$$

and so connected as that if the motion of any one of the four bodies be known those of the remaining three may be thence deduced.

In order to make the periodic times of C and D the same as that of A and B we must quadruple the

intensities of the gravitation; hence for all the periodic times alike we must have,

$$G_A = NZ \cdot NZ ; G_B = NZ \cdot NA$$

$$G_C = 4 \cdot NZ \cdot NE ; G_D = 4 \cdot NC \cdot NE.$$

If now, instead of supposing the intensities of gravitation to be different in order to have the periodic times alike, we suppose the four bodies to be subjected to one gravitation, the periodic times will be changed in the ratio subduplicate of the ratio of the gravitations; wherefore if, on the supposition of equal gravitation we put T_A, T_B, T_C, T_D for the four periodic times we shall have gravitations alike,

$$T_A = NZ ; T_B = NE$$

$$T_C = 2 \sqrt{NZ \cdot NE} ; T_D = 2 \sqrt{NC \cdot NE}.$$

These two pairs of conjugate motions are so connected that from one of them the other can readily be found, the law of connection being contained in the proportion,

$$NI : IZ :: NE + NZ : NE - NZ$$

or in

$$NI + IZ : NI - IZ :: NE : NZ.$$

If, then, from the pair A, B, we have deduced the pair C, D; we may from this latter deduce another pair of conjugate motions, which we may indicate by C_1, D_1 ; thence, again, another pair C_2, D_2 , and so on without limit. Or, if we regard C, D as the original pair and deduce A, B from it, we may thence, in the same manner, deduce a new pair A_1, B_1 ; from that another A_2, B_2 , and so on. Thus we have a progression of conjugate motions extending indefinitely each way and deducible one from the other.

THEOREM VI.

The time of descent in a circular arc may be computed with any required degree of precision by help of the series of conjugate motions.

Let it be proposed to compute the time of descent along the arc KN.

It has been shown in Theorem II. that this time

is greater than $\frac{1}{2} \pi \sqrt{\frac{l}{g}}$ and less than the pro-

duct of the same quantity by the secant of the angle NZK. When K is near the zenith, the angle NZK is nearly a right angle and therefore these two limits are very wide of each other. But if, from the arc NK we deduce the smaller arc NF we shall bring our determinations within much narrower limits, the ratio of those limits being now as radius to the secant of the angle NZF, that is as ZF to ZN. By proceeding a step further in the same direction and deducing from FN a new arc, we shall bring the limits still closer together, so that by repeating this process sufficiently often we may reduce the limit of error to any assigned degree of minuteness. It only remains to arrange the process in a manner convenient for calculation.

The proportion $NI + IZ : NI - IZ :: NE : NZ$ may be put in the form $NZ + ZK : NZ - ZK :: NZ : NF$, and if we put Bo for the angle NZK measured by half of the arc NK, B_1 for NZF measured by half of NF, the same proportion takes the form

$$1 + \cos. Bo : 1 - \cos. Bo :: 1 : \sin. B_1$$

whence

$$\sin. B_1 = (\tan. \frac{1}{2} Bo)^2.$$

The computation of the successive angles Bo, B_1, B_2 , etc., is thus a very easy matter. Halving the angle Bo we seek out $\log. \tan. \frac{1}{2} Bo$; and the double of this is $\log. \sin. B_1$; with equal facility we obtain B_2 , and so on, the arcs becoming more and more rapidly smaller as we proceed.

The same law of derivation may be exhibited graphically thus. Having drawn a horizontal line through N, fig. 3, make NS the fourth part of NK

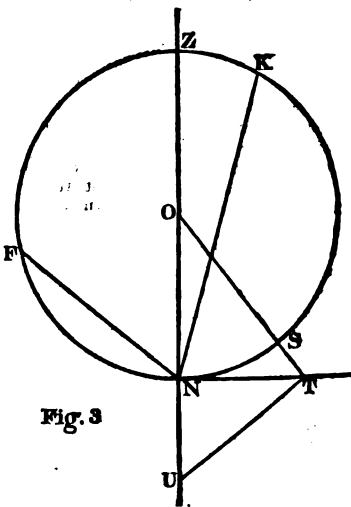


Fig. 3

is that the angle NOS may be half of Bo , join OS and produce it to T, draw TU perpendicular to OT meeting ON produced in U, then NT is $\tan. \frac{1}{2} Bo$ and NU is $(\tan. \frac{1}{2} Bo)^2$ on ON as unit: infect now the chord NF double of NU, and then NZF is the

angle B_1 . If, repeating the same process, we were to take the fourth part of NF and continue the analogous construction, the next arc would be exceedingly small, and the farther prolongation of the series would not be accomplished on account of the maintenance of the parts.

It has been shown that the times of descent in the arcs KN and FN are in the ratio of $2\sqrt{NC \cdot NE}$ to NE . But $NE : NZ :: NI + IZ : NI - IZ$, wherefore $NE \cdot NZ : NI^2 :: (NI + IZ)^2 : (NI - IZ)^2$, whence $NE \cdot NZ = (NI + IZ)^2$, so that

$$\begin{aligned} \text{time } B_0 : \text{time } B_1 &:: 2\sqrt{NC \cdot NZ} : \sqrt{NE \cdot NZ} \\ &:: 2NI : NI + IZ \\ &:: 2NZ : NZ + ZK \\ &:: 2 : 1 + \cos B_0 \\ &:: (\sec \frac{1}{2} B_0)^2 : 1 \\ &:: ON : OU \end{aligned}$$

whence we have

$$\text{time } B_0 = \text{time } B_1 \cdot (\sec \frac{1}{2} B_0)^2.$$

Similarly proceeding one step further, we obtain

$$\text{time } B_1 = \text{time } B_2 \cdot (\sec \frac{1}{2} B_1)^2$$

whence

$$\text{time } B_0 = \text{time } B_2 \cdot (\sec \frac{1}{2} B_0)^2 \cdot (\sec \frac{1}{2} B_1)^2,$$

and if we continue the process indefinitely till we arrive at an angle B_n so small that its secant may not differ appreciably from the radius, and in which, therefore, the time of descent may be expressed by

$$\frac{1}{2} \pi \sqrt{\frac{l}{g}}, \text{ we shall obtain ultimately}$$

$$\text{time } B_0 = \frac{1}{2} \pi \sqrt{\frac{l}{g}} \cdot (\sec \frac{1}{2} B_0)^2 \cdot (\sec \frac{1}{2} B_1)^2 \cdot (\sec \frac{1}{2} B_2)^2 \cdot \text{etc.}$$

CONCLUSION.

When a mass of given dimensions is capable of turning on an axis which does not pass through its centre of gravity and is allowed to come to rest, it takes that position in which the centre of gravity is the lowest possible; and, by help of formulae which are quite well known, we are able to compute the time of a minute oscillation on either side of the position of repose, whether the axis of motion be horizontal or inclined; and the point of interest in the present investigation is to ascertain the ratio of the actual time of oscillation to the time in an infinitely small arc; this ratio is expressed by the product of the squares of the secants of the successive angles $\frac{1}{2} B$.

As an example we may propose to compute the time of oscillation in an arc of 358° extending to within one degree of the zenith point on each side. In this case the arc NK is one of 179° , and consequently the angle NZK is $89^\circ 30'$; hence $\frac{1}{2} B_0 = 44^\circ 45'$, the logarithmic tangent of which is 9.9962100 , and the double of this, viz., 9.9924200 is the logarithm of the sine of the next angle. NZF or B_1 ; B_1 is thus found to be $79^\circ 19' 34''.5$. The calculation may be conveniently arranged as in the following scheme, which explains itself, the result being that the time of oscillation in an arc of 358° is nearly four times that of a minute oscillation.

n	$\frac{1}{2} B_n$	$2 \log \sec \frac{1}{2} B_n$	$2 \log \tan \frac{1}{2} B_n$	$B_n + 1$
0	44 45 00.00	0.297 2566	0.992 4200	79 19 34.50
1	39 39 47.25	.227 2323	0.837 2445	43 25 44.46
2	21 42 52.23	.63 9354	0.200 2934	9 07 31.58
3	4 33 45.79	2 7571	7.804 6410	21 53.62
4	10 56.81	44	5.006 0322	2.06
5	1.03	0		

$$0.591 \ 1858 = \log. \ 3.901088$$

In this example it is seen that, even for such an extreme angle, five terms of the progression are sufficient when seven place logarithms are used, while the arithmetical operations involved are only tabular inspection and doubling.

The computation for this angle by the previously known methods would entail an enormous amount of labour.

For all arcs of oscillation which do not extend beyond $5^\circ 30'$ on each side, the first term of the progression is sufficient to give the utmost precision which is attainable with seven place logarithmic tables, and therefore, for all the purposes connected with horology or with experiments on the pendulum, the duration of a beat may be held as proportional to the square of the secant of the eighth part of the whole arc of oscillation; wherefore the number of beats per day is proportional to the square of the cosine, and the daily retardation to the square of the sine of the same eighth part.

DISSOLUTION OF COTTON HAIR.

By J. B. DANCER, F.R.A.S.

THE following paper, entitled "Remarks on the Microscopical Appearances of Cotton Hair during Dissolution in the Ammoniacal Solution of Copper," was read at a meeting of the Literary and Philosophical Society.—The structure of cotton hairs has occasionally furnished an interesting topic for con-

versation at the meetings of our Microscopical Section. Two of our members, Mr. Chas. O'Neill and Mr. Heys, have given considerable time and attention to this subject. Mr. Walter Crum, F.R.S., communicated to the Chemical Society a memoir "On the Cotton Fibre," and the manner in which it unites with colouring matter. His paper is illustrated with some beautifully executed drawings of the microscopical appearances of cotton in the natural state, and when mordanted, mercerised, and treated with various dyes; this paper is well worthy the attention of those interested in this branch of inquiry. His description of the ordinary appearance of the cotton fibre agrees so nearly with what I believe it to be, that I will take the liberty of referring to his paper. To Mr. Crum's description I may add that many specimens of cotton, especially on the cylindrical portion of the hairs, show transverse markings. At times these appear at tolerably regular intervals, they have been claimed as evidences of spiral structure; when, however, they are examined with magnifying powers of 1,000 to 1,200 diameters they proved to be cracks in the external membrane. Other portions of cotton exhibit longitudinal furrows, irregular in length and direction—having a shrivelled appearance something like the bark of an aged tree. In gun cotton, the transverse cracks are very numerous. From an examination of transverse sections of cotton, I incline to the opinion that there is an external membrane distinct from the true cell wall or cellulose matter. Inside the cellulose there is an irregular cavity; this, in some specimens (when viewed longitudinally), appears to contain granules, probably the remains of the organising fluid contents of the cell, the mucous matter which is seen in growing cotton as mentioned by Captain Mitchell, in his letter to Mr. Hurst, read at this society, March 22nd, 1864.

On the 21st of April, 1863, Mr. Chas. O'Neill made a communication to this section, "On the Appearance of Cotton Fibre during Solution and Disintegration;" these experiments referred to the application of Schweizer's solution of copper and ammonia. Under the action of this solvent, Mr. O'Neill considers that cotton exhibits spiral vessels situated either inside or outside the external membrane. In a paper, read by the same gentleman, on the 18th of May, 1863, it is stated that spiral vessels are seen during the solution of gun cotton in ether and alcohol. On the 21st of December, 1863, Mr. Heys read a paper before this section, in which he refers to spiral vessels in cotton hairs which seem to prevent the collapse of the tubes. The announcement of the discovery of spiral vessels excited my curiosity. Having often examined varieties of cotton under the microscope, without suspecting any such structure, I was naturally desirous of witnessing its appearance during dissolution. A careful examination of cotton in the copper solvent, with powers varying from 50 to 1,200 diameters, showed me the appearances described by Mr. O'Neill. I could not, however, endorse his interpretations of them. On the 16th of January, 1865, I sent a letter to the chairman of the microscopical section, stating my belief that the spiral appearances could be clearly traced to a mechanical action which the solvent exerted on the vegetable cell, and that at some future time I hoped to illustrate this to the members of the section.

Since December last, I have subjected cotton during microscopical examination to a variety of influences in acids, alkalies, metallic solutions, iodine, and also gun cotton in varied proportions of ether and alcohol. Repeated experiments tend to confirm my disbelief in the existence of spiral vessels, properly so-called, either inside or outside cotton hairs. It would be difficult to explain, by means of drawings, how these pseudo spirals are created, and I have, therefore, supplied a number of microscopes for the purpose of showing at the close of the meeting the actual appearances. I shall now attempt a brief explanation to enable the members to comprehend more readily what they will see under the microscopes. In order to observe the action of the copper solvent on cotton, place a few hairs about a quarter of an inch in length on a glass plate, and cover them with thin glass; it is useful to rub a little beeswax on the glass plate in such a manner as will just support the covering glass to prevent too great a pressure on the cotton; then arrange the cotton under the microscope with a power of not less than 200 diameters. The solvent should be applied by a glass pipette to the edge of the covering glass whilst the observer is looking through the microscope (this is important). If the solvent is very strong, the action is too rapid for the eye to follow, if of moderate strength it will be seen that as soon as the solvent comes into contact with the cotton in the field of view, a rapid rotation or twisting of the hairs takes place. In my opinion, it is this rotating action which brings about the appearances which have been mistaken for spiral vessels.

The explanation which I have to offer for the phenomenon is this: first, we have the external membrane of the cotton, then the cellulose and primordial utricle, and finally, the dried contents in the cell, which I take to be the remains of the organising fluid. Observation shows that the external

membrane is not elastic and only partially soluble. The cellulose is exceedingly elastic and soluble, and expands to a remarkable degree in the act of dissolution. The contents of the cell behave in a similar manner to that of the external membrane; it is neither elastic nor very soluble. The most successful experiment is made by allowing the copper solvent to come at once into contact with some length of the cotton hair. The solvent permeates some parts of the external membrane more easily than others, and causes a rapid expansion of the cellulose, which bursts the external membrane; and, as this action is taking place at various portions of the same hair, a tangential force is exerted which twists and contorts the cotton in the direction of its length, and thus a spiral appearance is given to the whole structure of the cell. The non-elastic external covering is twisted round the expanded cellulose, sometimes as a single band, at others like a bundle of fibres. In those parts where the external covering has given way all round the hair, the cellulose expands into a bulb, pushing back the external membrane into a series of folds which form a ligature, and resists the expansive force of the cellulose. A number of these ligatures cause the expanded cellulose to assume the appearance of a string of beads. The lateral expansion of the cellulose contracts the length of the hair, and this causes the contents in the cavity of the cell to assume a corrugated appearance; this corrugation has also been subjected to the twisting power along with the other parts of the cell, and thus its spiral appearance is produced.

What becomes of the primordial utricle, I cannot state with certainty. After the disappearance of the cellulose there is an envelope left, which surrounds the contents of the cavity; this may be the primordial utricle, or the film left by the drying up of the protoplasmic or organising fluid. If the solvent is made to come into contact with the ends of recently-cut cotton a beautiful trumpet mouth is produced—the exposed surface of cellulose has expanded and pushed back the external covering into folds—the contents of the cell may, in this case, be seen projecting from the mouth of the trumpet form. Long after the complete dissolution of the cellulose has taken place, the external membrane remains just as the rotation or twistings had left it. Some portions in the form of rings, which had been the ligatures between the bulbous expansions, other portions as irregular spirals. The cell contents also remain as twisted corrugations. From the observed difference in solubility between the cellulose and the external and internal matter, I should imagine a difference in constitution. A few experiments have led me to suspect that some of the spiral appearances observed in hemp and flax fibres during dissolution may possibly be caused by the mechanical action of the solvent employed. I should add that in making the cupric oxide with ammonia, the oxide of copper requires a thorough washing before dissolving in the ammonia. The presence of any salt of ammonia, even in very small quantities, interferes with its power in dissolving cotton.

Correspondence.

STEEL RAILS.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Referring to an article on the above subject in your issue of the 23rd June, I note that you have omitted any remark on the subject of adhesion. I do not believe that the same amount of adhesion can be obtained with steel rails and steel tyres as with iron rails and iron tyres, and therefore court opinions on this point.

With regard to the subject of rigid permanent way, perhaps you are not aware that the Manchester and Bolton Railway was laid upon longitudinal granite blocks or sleepers, and that the road was so rigid and destructive to the rolling stock that the granite bearings were substituted by wooden sleepers. After the above experience it is surely a mistake to recommend cast iron bed-plate bearings, which could only produce a similar result to that obtained on the Manchester and Bolton Railway.

Sir, yours respectfully,
Greenwich, July 13, 1865. JOHN TODD.

TO CORRESPONDENTS.

THE MECHANICS' MAGAZINE is sent post-free to subscribers of £1 *la.* *sd.* yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. E. A. Brooman, of 166, Fleet-street, E.C.

Advertisements are inserted in the MECHANICS' MAGAZINE at the rate of 6d. per line, or 5d. per line for 6 insertions, 4d. per line for 12 insertions, 4d. for 26 insertions; and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editor, 166, Fleet-street.

To insure insertion in the following number, advertisements should reach the office not later than 5 o'clock on Thursday evening.

We must absolutely decline attending to communications unaccompanied by the name and address of the writer, not necessarily for insertion, but as a proof of good faith.—Ed. M. M.

RECEIVED.—J. and G.—A. W.—W. B.—W. J.—E. S.—J. N.—W. L. W.—G. H.
C. P. D. (New Cross).—We do not know of any cheap form of handy book of practical rules for drawing curves formed by Conic sections, and others including the "Trochoid." The best book is "Cramer (G), Introduction & l'Analyse des Lignes Courbes," 4to, Geneva, 1750; the price is about two guineas.

Miscellaneous.

It is stated that a company of Melbourne capitalists intend to place a line of light-draught steamers on the Murray, to trade between Echuca and the ports up and down the river. These vessels are to draw from 18 to 24 ft. of water, and are to be constructed of iron.

A singular accident happened recently in Springfield, Mass. A five-foot driving wheel for a locomotive, just from the foundry, was lightly tapped with a hammer by a workman, when it burst and a portion of the rim and several spokes, in all nearly a quarter of the entire wheel, flew.

The Act to facilitate the more useful Application of Sewage in Great Britain and Ireland was issued on Friday last. It recites that it is expedient to remove difficulties under which local boards and other bodies labour in disposing of the sewage in their districts so as not to be a nuisance, and to give facility to such authorities to make arrangements for the application of such sewage to land for agricultural purposes. There are various provisions in the act. The sewer authorities are to prevent the pollution of streams, and to dispose of the sewage.

At the last meeting of the Polytechnic Association of the American Institute, Mr. Charles E. Emery, an engineer in the U. S. Navy, exhibited a balanced slide valve, which seems to be one of the most promising that has yet been invented. A hole is cut in the back of the steamchest directly over the valve, and is covered by a plate which is connected with the valve by a rigid stem. It will be seen that the valve and plate both wear in the same direction, so there is no tendency to produce a leak.

A plan of preventing boiler incrustations recently adopted in France, consists in lining the boiler with a metallic network at some distance from the sides. The lime salts will of course be deposited upon this network, which can be easily removed, and from which the crust can be easily detached.

Messrs. Grosse and Blackwell have lately added to their works a platinum steel coil, made of pure platinum tubing, tested to a steam pressure of 60 lbs. to the square inch, to be used in boiling the pickling vinegar. This coil is the first of the kind that has been made. It boils 325 gal. of vinegar (the capacity of the vat) in one hour and a quarter, with steam at 30 lbs. pressure. It is made of pure platinum, autogenously soldered. The length of tubing $1\frac{1}{2}$ in. diameter, consumed, is 32 ft. It was manufactured by Messrs. Johnson and Matthey, at a cost of £800.

At a recent meeting of the American Iron and Steel Association at Chicago, Illinois, Capt. E. B. Ward, of Detroit, President of the Association, informed the members that a steel rail had been rolled at the Chicago rolling mills on the previous day. The ordinary rollers had been used, and the steel rail had been rolled most effectually. The rail was subsequently brought into the room and inspected. The first steel rail made at Chicago was from an ingot manufactured by the Bessemer process at Capt. Ward's works at Wyandotte, Michigan. A number of the principal American railways are already trying steel rails of English make.

It has been found that a hemp rope used for winding in a coalpit 200 yards deep, lasted about fifteen months with ordinary working, drawing from 150 to 200 tons per day. A round iron wire rope under the same work lasted twelve or thirteen months, while a flat wire rope lasted only about eleven months.

It appears that the Anglo-Indian Telegraph Service is again interrupted; on the slightest pretext the Ottoman authorities occupy the whole Asiatic line for days; the reply given, when explanations are demanded, being that the line is required for important Government business. Even admitting that it is, it makes out a strong case for the English Government obtaining another line. If this unsatisfactory state of things be allowed to go on, it will be necessary to depend more and more on the service via Russia and Persia. The India Office has now a good opportunity of enforcing its views on the Turkish director-general of telegraphs, Agathon Effendi, who happens to be in London at present.

The new No. 11, or North Inlet dock, at Portsmouth dockyard, was successfully opened last Tuesday by the entrance of the iron frigate "Minotaur" at high water. The dock will in future be known as the Minotaur dock, being named after the first ship it received on its blocks.

The Royal Academy of Sciences of Brussels has awarded its gold medal to M. Caron, for an essay embodying the results of his extended and laborious researches with respect to the constitution of steel. Mr. Stas has expressed his entire concurrence in M. Caron's conclusion that iron, in passing into the condition of steel, does not take up any nitrogen in addition to that which it originally contained.

On Friday last the new communication between Euston-square and London Bridge was opened for public traffic by means of a series of trains passing over the London and North-Western, South-Western, and South-Eastern Railways. There will be ten trains each way daily (Sundays at present excepted), between Kensington and Waterloo, Blackfriars and London Bridge Stations direct, while there will be fourteen trains each way daily (on week days only) between Waterloo, Blackfriars, and London Bridge Stations. By the opening of this important railway link, the Waterloo Station of the Charing-cross Railway has at last been brought into public use. The traffic by the new route will no doubt be eventually very great.

The celebrated Armstrong gun which was presented by Armstrong to the Southern Confederacy, and was used by them in the defence of Fort Fisher, has been taken to the Washington Navy Yard. It is a magnificent piece of ordnance, mounted upon a rosewood carriage elaborately made and decorated.

The applications of graphite—or black lead, as it is sometimes called—have become more numerous of late; thus it is extensively used for electric purposes, the glazing of gunpowder and shot, black lead pencils, and last, but not least, the making of plumbago crucibles. The total quantity of graphite exported from Ceylon in 1862 was 40,195 cwt., of which no less than 34,730 cwt. was shipped to Great Britain.

Naples advises to the 5th inst. state that Vesuvius continues to emit fire from its principal mouth. In the opinion of competent persons, however, there appears to be no reason to apprehend an imminent complete eruption.

About a year ago MM. Fremy and Chevreul started a laboratory in France in which poor and ardent students might work, and have the advice of the two worthy professors named, gratis. M. Duray, the Minister of Instruction, has recently made a grant of 10,000 francs, and M. Méniér has offered to supply the chemicals for nothing, and thus the cost of the establishment has been provided for, although the professors still superintend it without fee. The generosity of M. Méniér does not end with the supply of the chemicals; it is said that a few students who show special aptitude for research receive pecuniary assistance from a fund which has been placed at the disposal of the professors.

It was generally anticipated that the Great Western Railway Board would have come to a decision as to the removal of their works to Oxford at their meeting on Thursday last, but there was so much business to be done that the subject was postponed for a week. As the board, however, had satisfied themselves that the works and dwellings for the artisans will be in a healthy and suitable locality, there appears to be no doubt that they will adhere to their original arrangement to move the works to Oxford, in spite of the vexatious opposition offered by certain members of the University.

It is estimated that upwards of 9,000 steam engines, for oil wells and other purposes, have passed over the Atlantic and Great Western Railroad into Pennsylvania "Oildom." The engine-builders have certainly "struck ile."

Application has been made to the Swiss Government for a concession for an Alpine Pass Railway, which will connect the lines of Northern and Southern Europe.

Excursion trains are now running from Paris. One started on Wednesday, going via Switzerland and the Rhine to Cologne, Mayence, Munich, Prague, Vienna, &c. The trip lasts thirty days, and tourists are boarded, washed, and their minds improved for £32.

Of all metalloids arsenic is most easily isolated by electricity, for it is almost as good a conductor as a metal. By means of an apparatus (known as simple in electro-chemistry), all the metalloids they contain may very rapidly be extracted from arseniferous substances. Place a solution of arsenical matter in a platinum vessel, plunge a zinc wire into the liquid, and the arsenic will appear on the platinum; by prolonging the action the whole of the arsenic is extracted from its compound. This method may be varied in different ways, and renders valuable service in medicinal researches; it is much superior in sensibility to the process actually in use.

There were 6,424,874 kilogrammes of cast iron imported into Paris during the first five months of the year 1864, together with 11,288,019 kilogrammes of unwrought iron. The imports during the corresponding period of the present year amount to only 5,497,062 kilogrammes of cast iron and 7,770,247 kilogrammes unwrought iron, showing a considerable diminution.

A model of the sea-going turret-ship, designed by Mr. Scullard, the Chief Admiralty Draughtsman at Portsmouth dockyard, to meet the views of Capt. C. P. Coles in the construction and fitting of a vessel carrying one turret mounting two 600-pounders, as a competitive vessel with Mr. Reed's "Pallas," has been completed at Portsmouth yard and forwarded to the Admiralty. The model has been greatly admired on account of the beautiful form of its hull, which gives promise of high speed, with superior sea-going qualities, the clear manner in which the details of hull, fittings, and rig are shown, and the very careful workmanship.

We learn that last winter the Queen was pleased to favour Mr. Peter Stewart, spinning-wheel maker, Spitalfield, Perthshire, with an order for a two-handed spinning-wheel for Her Majesty's use. Mr. Stewart, who is an adept in his profession, having spent upwards of sixty years at it, has with great care and taste executed the order. The wheel was sent to the Queen before her departure from Balmoral.

The steamboats which perform the voyage regularly between Paris and London and back have given the Parisians a pretext for boasting that Paris is at length a seaport. They make the voyage from Paris to Rouen in from 17 to 20 hours, and back to Paris against the tide in from 20 to 25. There are other boats of from 50 to 200 tons which navigate the upper Seine with lighters of from 40 to 120 tons.

The Metropolis Sewage Company will be able to irrigate about 3,000 acres of land at once from the outfall of the Board of Works, the profit of which for the four years before the commencement of the right of the Board of Works to participate, will belong exclusively to the company.

Two establishments in the east of France have already availed themselves of the Treaty of Commerce with the Zollverein, and have contracted for the supply of 200 or 300 railway waggons with a German company. The proprietors of the ironworks of Graffenstaden are said to have contracted to supply the Baden Railway Company with 24 locomotives, of which the boilers it is said are to be constructed of steel plates.

It appears that telegraphic communication with India is suspended, and it is feared that the difficulty on this occasion is through some break or fault in the Gulf cable.

Several meetings of the shareholders in French joint-stock iron companies have been held lately, and the reports presented by the directors exhibit the difficult position in which the proprietors of ironworks are placed. Among the remedies suggested are a pressing appeal to the Government to complete the works for improving navigation by canals and rivers and the reduction of the tolls. They demand of the railway companies to remove the inequality which exists in their tariffs, so injurious to the supply of ironworks with minerals.

It is difficult to obtain tellurium in a compact mass by the electro-chemical method; Ritter could only extract it from a saline solution in a pulverulent state.

During the week ending the 8th inst., the visitors to the South Kensington Museum have been as follows:—On Monday, Tuesday, and Saturday, free days, open from 10 a.m. to 10 p.m., 11,121. On Wednesday, Thursday, and Friday, Students' days (admission to the public, Sixpence); open from 10 a.m. till 6 p.m., 2,470. Total 13,591. The total number of admissions since the opening of the Museum is 5,401,940.

The International Railway Company, formed for constructing a line from Terneuzen, on the Scheldt, to Malines, have invited application for a portion of their capital which remains unsubscribed. The railway is to be forty-three miles in length, and will, it is represented, save three hours in the journey from London to Aix-la-Chapelle and Cologne.

Gas lighting was first tried in Paris, on December 31st, 1829, the Rue de la Paix being the scene of operations. After July, 1830, it was introduced into the better quarters. In 1859 there were eight companies, with a capital of 30,000,000f. These were formed into the "Compagnie Parisienne." At present there are ten gas-works, which employ 2,700 people and 43 engines of 500 horse-power. In 1863 the consumption of Paris was 100,833,258 cubic metres.

By a recent report it appears that the Thames ship yards turn out 117,000 tons of iron vessels annually. On the Clyde there are thirty-three yards that in 1863 produced one hundred and seven iron vessels, with an aggregate of 120,000 tons. On the Mersey iron vessels are turned out to the aggregate of 80,000 tons annually; on the Tyne, 51,206; on the Wear, 25,000; and on the Tars, 15,000—making a total annual aggregate of 408,996 tons constructed on the above-named rivers. Iron vessels are also built at Bristol, Belfast, and other places. The total tonnage of iron vessels built during the year 1864, in Great Britain, may be estimated at about 500,000 tons.

According to the *Industrie*, M. Quillaq, mechanical engineer, of Anzin Nord, has received an order to make a powerful pumping machine for a coal mine near Newcastle. This will be the first machine of the kind ever sent from France to England.

The Leeds district has for some time past been gradually monopolising the large contracts for wrought-iron girders for bridges, large screw steamers, blocks of cast iron for steam hammer beds, and other large castings for machinery. Some difficulty has hitherto been experienced in loading heavy goods of this description into railway trucks. The loading of a girder, &c., of 20 tons and upwards without the aid of a powerful crane, is a task involving no small amount of difficulty and risk, and the want of such a crane in Leeds has caused much inconvenience. The Great Northern Railway Company have, therefore, lately fixed in their goods' yard an "overhead" traversing crane, capable of lifting 30 tons and upwards. It consists of two large wrought-iron box girders—the breaking weight of each of which is 120 tons—resting on two massive piers of brickwork, 20 ft. high, supporting a powerful crab, which traverses a length of 62 ft., spanning two lines of railway. The girders and crab were manufactured by Mr. Robert Crosland, Union Foundry, Bradford.

Patents for Inventions.

ABRIDGED SPECIFICATIONS OF PATENTS.

THE Abridged Specifications of Patents given below are classified, according to the subjects to which the respective inventions refer, in the following Table. By the system of classification adopted, the numerical and chronological order of the specifications is preserved, and combined with all the advantages of a division into classes. It should be understood that these abridgements are prepared exclusively for this Magazine from official copies supplied by the Government, and are therefore the property of the Proprietors of this Magazine. Other papers are hereby warned not to produce them without an acknowledgment.

BOILERS AND FURNACES,—3205, 3217, 3234
BUILDINGS AND BUILDING MATERIALS,—3187, 3192, 3195, 3214, 3221, 3222, 3228
CHEMISTRY AND PHOTOGRAPHY,—3175, 3203, 3215, 3229
CULTIVATION OF THE SOIL, including agricultural implements and machines,—3223
ELECTRICAL APPARATUS,—None
FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.,—3176, 3186, 3189, 3190, 3191, 3199, 3200, 3210, 3224, 3226, 3235, 3237
FOOD AND BEVERAGES, including apparatus for preparing food for men and animals,—3184, 3206
FURNITURE AND APPARATUS, including household utensils, time-keepers, jewellery, musical instruments, &c.,—3194, 3220, 3224, 3236
GENERAL MACHINERY,—3168, 3169, 3173, 3181, 3182, 3188, 3198, 3204, 3208, 3209, 3216, 3212, 3230
LIGHTING, HEATING, AND VENTILATING,—3178, 3180, 3212
METALS, including apparatus for their manufacture,—3206, 3212
MISCELLANEOUS,—3160, 3177, 3183, 3193
ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.,—3172, 3174, 3201, 3202, 3211, 3218, 3227, 3233
SHIPS AND BOATS, including their fittings,—3172, 3197
STEAM ENGINES, &c.,—3171, 3232
WARFARE,—3196, 3231

3168 C. G. HILL. *Improvements in machinery or apparatus employed in the manufacture of bonnets and cap fronts, rouches, and millinery or other trimming, and in the manufacture and production of the same.* Dated December 21, 1864.

The first and second parts of this invention consist in certain arrangements (the details of which we cannot here quote) of the goffering chains, wires, plates, &c., employed. The third part consists in means for enclosing a wire in a binding piece, in which latter is also enclosed the edge of the bonnet front, &c. *Patent completed.*

3169 M. HENRY. *Improvements in governors.* (A communication.) Dated December 21, 1864.

We cannot here give space to the voluminous details of this invention. *Patent completed.*

3170 F. TOLHAUSEN. *A new and improved method of aggregating coal dust.* (A communication.) Dated December 21, 1864.

This invention consists, mainly, in combining coal dust with starch water or a hydrated solution of dextrine or other cohesive products derived from wheat, rye, corn, potatoes, rice, &c. *Patent completed.*

3171 J. RAMSBOTTOM and T. BLACKBURN. *Improvements in the construction of hydraulic and other engines for obtaining motive power and for compressing and measuring fluids.* Dated December 21, 1864.

These improvements comprise such an arrangement and combination of parts, as well as new features, as will enable the patentees to obtain high velocities, greater freedom from counter action, and a compact as well as economical machine, well adapted for extending advantageously the use of water in motive power engines. *Patent completed.*

3172 J. W. COWLES and W. WARREN. *Improved apparatus for facilitating communication by signals between different parts of a railway train, parts of which apparatus are also applicable to other purposes.* Dated December 21, 1864.

This invention consists in the employment of a cord running the length of the train, which cord is connected with a ratchet wheel, spring, and other appliances contained in a box on the roof of each carriage, the whole being so arranged that, on pulling a cord inside the carriage, a disc signal is projected from the side of the carriage. *Patent abandoned.*

3173 L. R. BODMER. *Improvements in the mode of working hydraulic presses, cranes, lifts, and other machinery and*

apparatus actuated by water pressure, and in machinery and apparatus connected therewith. (A communication.) Dated December 21, 1864.

This invention consists, firstly, in the application of that class of machinery known as centrifugal pumps for the purpose of working hydraulic presses, hydraulic lifts, and every description of machinery adapted for being actuated by water power, and also for transmitting power or motion generally. Every description of centrifugal pump is applicable and more or less suitable for the purpose, but the inventor prefers the use, for certain purposes, of a pump constructed on a special principle, and which, together with the general arrangements in connection with the same, or with other centrifugal pumps, forms the second part of this invention. *Patent abandoned.*

3174 W. REID. *Improvements in the arrangement and construction of waggons or vehicles for the conveyance of cattle upon railways.* Dated December 21, 1864.

This invention consists in constructing cattle waggons with water troughs, which troughs form part of the wagon. *Patent completed.*

3175 J. H. JOHNSON. *Improvements in photographic apparatus.* (A communication.) Dated December 21, 1864.

By this invention, the two operations of rendering the plate sensitive and of developing the image or picture are both effected without the removal of the plate from the camera, or taking it into the dark room. *Patent completed.*

3176 J. HARGREAVES. *Improvements in looms for weaving.* Dated December 21, 1864.

The main features of this invention consist in forming in the double tappet a number of dwells, and in causing the pattern cylinder to be moved to and fro sideways. *Patent completed.*

3177 R. WILSON. *Improvements applicable to call and other bells.* (Partly a communication.) Dated December 22, 1864.

This invention consists in the use of a lever working on a fixed bearing or between fixed bearings, on a frame either on the inside or the outside of the bell, to the end of one arm of which lever the clapper is affixed so as to hang away from the bell and always to fall into the same position by its own gravity, the other arm of the said lever being cranked or bent to any required angle with the clapper arm, so as to enable a spindle or rod to be connected to its end for actuating the clapper. *Patent completed.*

3178 H. EDWARDS. *Improvements in the construction of lamp feeders and other vessels from which fluid is poured out through tubular spouts.* Dated December 22, 1864.

This invention consists in establishing means for air communication between the outlet of the spout of the lamp feeder or other vessel, from which fluid is poured out through a tubular spout (whether long or short), and the interior of the vessel itself, which must either be air-tight or capable of being made so. *Patent completed.*

3179 J. and J. H. FOTHERGILL. *Improvements in machinery or apparatus in the propulsion of vessels.* Dated December 22, 1864.

This arrangement of apparatus consists in the use of one pair or more of cylinders at the stern, fore part, or midships, or thereabout, of a vessel; each such cylinder is open at one end towards the water, the opposite ends of the cylinder being closed and provided with a stuffing-box, through which a rod is passed; one end of each such rod is provided with a piston sliding in the cylinder, and the other end of the rod is attached to a connecting rod, which proceeds from a crank on the main shaft or on an intermediate shaft of a steam engine, or other motive power engine. The patentees employ two or more such cranks, each crank being provided with bearings and with rods and connections for attaching the first-named piston rods to the main shaft or intermediate shaft before named. Beside driving one or more paddle wheels, screws, or other equivalents, the steam, hot air, or the equivalent thereof, will drive or force out the pistons in the cylinders first named, such pistons being assisted in their outward thrust by either steam, hot air, or the equivalent thereof. When each piston has arrived at the end of the outward thrust, a vacuum is formed between the pistons and the closed ends of the cylinders by means of an air pump, the piston of which is moved by a crank or by other contrivances attached to the main or the intermediate shaft above referred to. The second method or arrangement is a modification of the first, but here, instead of employing either plain or compound pistons in the first cylinders, the patentees employ trunk pistons; the trunks in the outward thrust being thrust into the water, and a vacuum being formed at the closed ends of the cylinders, the return stroke of the pistons will be assisted by the pressure of the water outside. Sometimes, instead of producing a vacuum, they employ cylinders, having one end open to the water, and the back end also open to the water by means of pipes, which may be so arranged that the streams of water issuing therefrom may form the means of steering the vessel; or separate cylinders may be used for the purpose. *Patent completed.*

3180 J. G. ARAM. *Improved mode of lighting household and other fires.* Dated December 22, 1864.

This invention consists in the application to the coal, coke, or other fuel of a lighted jet or jets of inflammable gas (coal gas by preference) to any convenient part of the fuel it is desired to ignite. Such jet or jets, when coal gas is used, may either be supplied from gasfittings used for illuminating purposes by means of a flexible hose or india-rubber pipe fitted temporarily on to a gas burner; or a small main for the purpose may be laid from the ordinary gas main. *Patent completed.*

3181 C. G. WILSON. *Improvements in machinery for pressing cotton or other elastic substances.* Dated December 22, 1864.

This invention consists, first, in acting two hydraulic cylinders combined so that one cylinder becomes in the latter part of the operation the ram of the other cylinder of larger diameter in completion of the desired pressure; and, second, in using screw racks and gearing, or other arrangements, instead of the small cylinder in the first part of the operation, so that the said screw or screws may serve as compression struts for the final pressure from one or more hydraulic cylinders. *Patent completed.*

3182 J. BRANK. *Improvements in governors.* Dated December 22, 1864.

The principle of this governor is that the centrifugal force of the balls at the extremities of the revolving pendulum is equilibrated at any required speed by the force of gravity of an adjustable counter weight, or the tension of a spring, by which means a valve may be actuated or machinery controlled. *Patent completed.*

3183 A. ALISON. *A new species of currency, by which a commercial crisis arising from the want of gold may be at all times prevented.* Dated December 22, 1864.

Provisional protection has not been allowed for this invention.

3184 R. L. HOWARD and J. DAUGLISH. *Improvements in apparatus for making aerated bread.* Dated December 22, 1864.

This invention relates to, first, the mode of discharging the dough; second, to the apparatus for making and mixing the dough; third, to the apparatus for condensing and exhausting gas and air; and consists under one important part of the invention in placing between the mixing vessel and the apparatus through which the dough is to be discharged for division into loaves a vessel or chamber, into which the dough may be discharged in bulk, in which vessel or chamber is to be retained a sufficient pressure of gas to prevent any injurious exhaustion or vesiculation of the dough, and to effect its discharge therefrom through the regulating apparatus for making into loaves, which is to be affixed thereto, instead of to the mixing vessel as heretofore. *Patent completed.*

3185 J. GILLESPIE. *The improved construction and manufacture of retorts, crucibles, glasshouse pots, and other similar vessels, and in the means and apparatus employed therein.* Dated December 22, 1864.

The principal feature of this invention consists in forming or constructing the whole of the greater part of the walls, sides, ends, or bodies of retorts, crucibles, glasshouse pots, and other generally similar vessels, of two or more layers or thicknesses of whatever material they may be made with, or having thin or slight divisions, spaces, or partings between the contiguous or adjacent surfaces of such layers or thicknesses. *Patent completed.*

3186 J. B. EDGE and E. HIRD. *Improvements in the process of finishing cotton heald and other doubled yarns, and in the machinery or apparatus employed therein.* Dated December 23, 1864.

In carrying out this invention the patentees employ an improved adhesive substance or mixture in the trough or troughs of the doubling machine, the said trough being placed between the bobbins and rollers. The improved mixture is composed of farina, linseed, palm or cocoa nut oil, gum arabic, common soda, white wax, and the whites of eggs in certain proportions. *Patent completed.*

3187 T. P. HAWKINS. *Improvements in fencing and other staples.* Dated December 23, 1864.

This invention consists in making fencing and other staples with flat chisel points or ends. *Patent abandoned.*

3188 G. HASELTINE. *Improvements in machinery for manufacturing metallic nuts.* (A communication.) Dated December 23, 1864.

The object of this invention is to manufacture automatically from heated bars of metal nuts for screw bolts by means of cutting, punching, and forging dies, with corresponding counter dies, so combined and operated that the nut blank is cut from the bar, punched and forged by successive operations, and discharged from the machine completed for tipping. *Patent completed.*

3189 E. TACONET. *Improvements in looms by the addition of one or more reeds to the ordinary reed to facilitate the division of the warp during the weaving.* Dated December 23, 1864.

In performing this invention the inventor adapts to the batten or lay carrying the ordinary reed a second reed and, if needful, several reeds, intended to divide the warp threads before they pass into the batten reed. *Patent abandoned.*

3190 W. E. GEDGE. *Improved means and apparatus, by the use of which a stripe or border may be woven on napkins, table cloths, and other fabrics by the power loom.* (A communication.) Dated December 23, 1864.

This invention is not described apart from the drawings. *Patent completed.*

3191 J. PATERSON. *Improvements in the treatment of jute and other fibrous substances, and in the machinery, apparatus, or means connected therewith.* Dated December 23, 1864.

This invention consists in the use of certain grooved and fluted rollers, whereby the batching and softening of fibrous substances are expedited. *Patent completed.*

3192 J. BETHNELL. *Improvements in preserving wood.* Dated December 23, 1864.

This invention consists in forcing into the pores of wood various kinds of tars and oils; also the vapours from all kinds of coals, bitumens, various kinds of wood, and many other substances. *Patent completed.*

3193 J. F. WHEELER. *A new or improved combined portable inkstand, pen and pencil holder.* Dated December 23, 1864.

This invention relates to a combined inkstand, pen and pencil holder, arranged in a very small compass, suitable for being suspended as an ornament from the watch chain or otherwise. *Patent completed.*

3194 T. and J. FAGG. *Improvements in the manufacture of boots and shoes.* Dated December 23, 1864.

The inventors propose to continue the vamp of the boot or shoe to form a lapet or outer tongue or flap, with or without a seam across the vamp; the hind part or ankle piece of the boot being open in front, meets over the instep, and is covered by the tongue or flap, and secured thereto by a flat lace on each side passing through semi-circular metal loops on the edges of the flap, and on the body of the hind part. *Patent abandoned.*

3195 R. A. BROOMAN. *Improvements in coke ovens.* (A communication.) Dated December 23, 1864.

This invention consists in constructing a circular multiple oven in manner hereafter described. The object is to unite a quantity of ovens in a small space, and to so arrange them that each of the ovens shall converge to the centre of the building, in order that the heat of the united ovens may be equal for each of them. Each separate oven participates in the heat of its neighbours. The flame from each oven is divided by flues spread over each side of its walls, and produces a great heating surface upon and under the sole of the oven. The number of converging ovens is not limited, but depends upon the diameter to be given to the structure, but twenty-eight ovens arranged in the same structure will yield a great quantity of coke with a considerable saving in labour. *Patent completed.*

3196 R. A. BROOMAN. *Improvements in portable firearms and cartridges.* (A communication.) Dated December 23, 1864.

In constructing cartridges according to this invention the inventor uses a case with the edges of the rear end

flanged out, and he attaches thereto a base of felt, or other suitable plastic material. This base is pierced with a central hole closed at top and bottom by a thin disc, preferably of paper; to the upper disc, that next the charge, he causes a fulminating composition to adhere; the thickness of the base is such that no shock can bring the lower disc in contact with the composition. At the moment of ignition, produced by a needle which pierces the two discs, the surface of the hammer which carries the needle is pressed forcibly against the base, and prevents all escape of gas from the rear of the cartridge. The improvements in portable fire-arms apply to the locks and rear of the barrels, and are intended especially to be used with the improved cartridges before described, though each part of this invention may be used separately. The improvements in fire-arms cannot be described without reference to the drawings. *Patent abandoned.*

3197 E. SAUNDERS. *Improvements in affixing armour plates to vessels and other structures, and in bolts, screws, spikes, and rivets to be used for these and other purposes.* (A communication.) Dated December 23, 1864.

This invention consists in the substitution of screw and other bolts, spikes, and rivets, formed, used, and applied in the manner hereinafter described for general fastening purposes, and amongst others the fastening or securing of iron and armour plates to marine and other batteries, ships of war, and other vessels, and for general purposes, in lieu of the solid metal bolts, spikes, and rivets, as hitherto formed and used. When solid bolts are used in affixing plates of iron to the above structures, they are liable to be either driven through, shattered, or broken by the impact of heavy projectiles; this liability increases as the size and consequent rigidity of the solid bolts are augmented, as in the case of thick and heavy plates in fastening which it becomes necessary to increase the size of the bolts in order that they may support as well as fasten the same to the underwork. To remedy the above defect in these fastenings is the object of this invention, which the patentee proposes to accomplish by making the body shank or centre part of the bolt, spike, or rivet, of a number of wires, rods, or strands twisted or so placed together that in transverse section they shall possess the required tensile strength, and at the same time a considerable degree of elasticity, and to make the heads and ends or points solid by heating and welding, hammering, or compressing the same. *Patent completed.*

3198 J. HAY. *Improvements in autograph stamps, and in apparatus connected therewith, parts of which apparatus may be employed for numbering.* Dated December 23, 1864.

This invention relates to certain improvements upon and modifications of the autograph stamp, and apparatus connected therewith, for which the patentee obtained letters patent, dated 24th June, 1864 (No. 1,595), and also to a mode of printing or preparing the permutation chart intended to accompany such stamps, and consists, firstly, in combining in the same case or holder with the improved autograph stamp a self-acting registering or numbering apparatus, of any convenient or well-known construction, whereby each change in the stamp will, at the same time, be indicated by the registering or numbering apparatus, which will show a number corresponding to the number in the chart opposite to the combination produced; secondly, of a peculiar construction and arrangement of self-acting registering or numbering apparatus, which may either be used in combination with the improved autograph stamp, or separately as a counting or numbering apparatus for other purposes, to which it is applicable; or it may be used as a stamp for printing the permutation charts which accompany the improved autograph stamp; thirdly, in the application and use of a slightly modified form of autograph stamp for printing the said permutation charts; lastly, of a peculiar form and construction of key, to be employed in effecting the changes in the said autograph stamp. *Patent completed.*

3199 W. H. MAITLAND. *Improvements in the construction of cotton gins.* Dated December 24, 1864.

This invention consists, firstly, in the employment of tubes of steel or other metal in place of solid rollers in the construction of cotton gins; secondly, in increasing the width of the machine; and, in order to prevent the springing of the lengthened tubular rollers, they are supported in a central bearing or bearings, as well as at the ends. The driving gearing, instead of being single, is duplicated and placed at each side of the machine, so as to act upon the rollers at opposite ends, or at both ends simultaneously, and so prevent torsion or twisting. *Patent completed.*

3200 E. FIELDING. *Certain improvements in power looms and apparatus connected therewith.* Dated December 24, 1864.

The first of these improvements relates to apparatus for preventing the shuttle when it misses the box from flying about amongst the machinery, or otherwise committing bodily injury to the attendants. On or about the spindle studs of the slay the inventor fixes a guard of sheet metal, or other suitable material. This guard projects upwards from the stud and is of such a breadth and height as to receive the shuttle when it misses the box. The second improvement relates to a further shuttle guard, which is supported from the framework of the loom. This guard may be of any suitable form, and fixed from the loom side so as just to clear the end of the slay when the loom is at work. It may be constructed of sheet metal, wood, wire grating, or other suitable material. The third improvement consists in the use or application of a hook or loop of a peculiar construction for the purpose of enabling the attendant to apply the cleaning material to remove the sediment or black mud which accumulates on the picker spindle. This hook or loop is of such a form as to pass betwixt the spindle and the picker, and thus enable the attendant to apply effectually the cleaning material. *Patent abandoned.*

3201 C. R. BARNER. *Improved signalling or communicating apparatus for railway carriages.* Dated December 24, 1864.

In performing this invention the inventor provides a square box with a reflector on the inside, the side towards the engine for instance. The side that faces the reflector is made to move on a pair of hinges, and to this is fixed a small rod communicating with a crutch, which is made to move up and down by means of a spring or springs affixed to the outside of the box. On the crutch being brought down parallel to the roof of the carriage, the rod fixed to the movable side of the box closes it, thereby excluding the light proceeding from the inside carriage lamp (reflected through a red glass in the movable side of the box), a spring on the roof of the carriage

retaining the crutch in its place until relieved by some person inside the carriage. To the crutch is attached a rattle or bell which sounds on being relieved as aforesaid, which is done by means of a handle or bell pull placed on a rod extending along the whole carriage, having arms placed on it so as to plumb the holes made for the wire, one of the arms being attached to a spring trigger. To prevent any person from trifling with the officials, a tell-tale should be placed inside the carriage, under the roof of the same, to become fixed on the release of the crutch, and this would point out the seat from which the pulling was effected. *Patent abandoned.*

3202 E. LEAHY. *Improvements in the construction and fitting of railway wheels.* Dated December 24, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

3203 B. MARGULIES and J. K. LEATHER. *Improvements in the manufacture of chromates and dichromates.* Dated December 24, 1864.

The object of this invention is to manufacture chromates and dichromates in a more economical manner than is now commonly practised. To this end the inventors prepare a mixture of lime, or of hydrate of lime, or of other alkaline earths, and of chrome ore, or of oxide of chromium (or of one or more of the impure compounds of chromium), with or without one or more of the salts of soda or potash, and with or without manganese or other oxygen bearing material, and with or without silica or other material not easily fusible (the use of which is to prevent the mixture from fluxing when exposed to a strong heat), and they form the same into blocks which they submit to the heat of a furnace until the chrome ore or oxide or other compound of chromium is decomposed. The blocks they prefer to make in the shape of the frustum of a cone. It is not necessary that any of the substances aforesaid be pure, and they may be used in equal parts by weight or in various proportions. From amongst the substances aforesaid, they prefer to use equal parts by weight of hydrate of lime, and sulphate of potash, and chrome ore, reduced to a finely divided state, and after well mixing them in any convenient manner to add water, and by kneading to bring the mixture to the consistency of clay, after which they mould it into conical blocks. The blocks thus formed they expose, whether in a dry or moist state, to the heat of a furnace or oven, but by preference they use the hearth of a reverberatory furnace, and subject the blocks to a heat gradually increasing from a low heat to a full red heat, or even to a white heat, being careful not to allow the heat to increase so as to flux them, as in that case the mass would be very difficult to lixiviate. The blocks are to remain in the furnace until the chrome ore, oxide of chromium, or other compound of chromium has been either wholly or partially decomposed. The blocks are then raked out and placed in any convenient vessel, and the soluble compounds of chromium dissolved out either with water, or with a solution of one or more of the salts of soda or potash, and the liquor is treated by any of the usual methods for the manufacture of chromates and dichromates therefrom. *Patent abandoned.*

3204 J. ROWBERRY. *An improved centrifugal drying machine.* Dated December 24, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

3205 A. V. NEWCOM. *Certain improved means for stopping leaks in boiler tubes.* (A communication.) Dated, December 24, 1864.

This invention relates to the application to leaky boiler tubes of a split ring, with or without a bead, in combination with one or more expanding wedges, in such a manner that, by the action of the wedge or wedges, the ring can be secured in the interior of the tube, and the leak stopped. *Patent completed.*

3206 T. ROBINSON. *Improvements in teapots, coffeepots, claret, hot water, and other jugs having metallic covers.* Dated December 24, 1864.

This invention relates to the means of opening the lids of teapots, coffeepots, claret and hot water jugs, in silver, electro plate, and other metals, by means of leverage, for which purpose a tube is placed through or by the side of the handle into the body of the pot. Within the tube is inserted a hollow rod containing a small steel spring. On the upper part of the rod or piston is a thumb-piece, and affixed to the lower end is a small curved piece of metal, attached to which is a small wheel, or roller, which works in a corresponding piece of grooved metal or lever affixed to the under part of the lid, but extended from the joint pin in an opposite direction to that of the lid, the joint of the lid forming the fulcrum. By pressing down the thumb-bit on the top of the rod, a leverage is obtained, by which means the lid is opened. The spring confined in the rod resting on a horizontal pin takes back the rod or piston to its original position, when compression ceases, or the weight of the lid may be brought to bear on it, and the spring dispensed with for that purpose. *Patent abandoned.*

3207 E. MOKKWOOD. *Improvements in coating metals.* Dated December 24, 1864.

The patentee claims,—Firstly, the general combination of parts forming the apparatus combined and arranged as described, and shown in the drawings. Secondly, the apparatus used for introducing the sheets or plates into the bath, and also that used for transmitting them through the bath, and also that used for providing for their exit or extraction from the bath, as described. Thirdly, the use of a copper bath for containing the preparatory fluid flux, and also the copper rollers whereby he conveys such sheets through the preparatory fluid flux bath, or between it and the coating metal, as described. Fourthly, the use of an inside bath or pan containing sand or other non-conducting matter applied as described. *Patent completed.*

3208 C. H. TAYLOR. *Improvements in machinery or apparatus for preventing accidents in mine shafts and for other like purposes.* Dated December 24, 1864.

This invention consists of the mechanical arrangements hereinafter described for preventing the descent of a skip or cage in a mine shaft on the accidental breaking of the chain or rope to which the skip or cage is connected. The said mechanical arrangements may also be applied to the prevention of accidents in ascending lifts used in warehouses, hotels, and elsewhere. At opposite sides of the mine shaft parallel vertical racks are situated, the said racks extending from top to bottom of the mine shaft. The cage or skip to be raised and lowered in the mine shaft works between guides on either side of the said racks. In a box or chamber situated either above or below the skip or cage is the following mechanism:—At those sides of the box

opposite the racks are toothed wheels or pinions, one on each side, the axes of which work in uprights in the said box, the teeth of the said toothed wheels or pinions engaging with the teeth of the fixed racks. On the axis of each toothed wheel or pinion is a ratchet wheel and two vertical levers, the upper ends of which are formed into paus and are situated between the ratchet wheels. By means of a sliding horizontal wedge, the lower ends of the said levers may be operated upon so as to lift the paus from the ratchet wheels; or the said sliding wedge may be moved so as not to affect the said levers, in which case springs acting on the said levers press the paus upon the ratchet wheels. The direction of the teeth of the ratchet wheels and the positions of the paus with respect to the said wheels are such that, when the paus are in gear with the ratchet wheels, the toothed wheels or pinions can rotate in the direction impressed upon them by the rising skip or cage, but are incapable of rotation in the contrary direction. The chain or rope for raising and lowering the skip or cage is connected to the top of the box described, or to the skip or cage, and in case of the accidental breaking of the chain or rope during the ascending motion of the skip or cage, the said skip or cage is suspended between the two racks by the paus, preventing the rotation of the ratchet wheels and toothed wheels or pinions in the direction necessary to permit the descent of the said skip or cage. When the skip or cage has ascended to the top of the mine shaft, the sliding horizontal wedge may be made to throw the paus out of gear with the ratchet wheels, when the skip or cage can easily descend. When the loaded skip or cage is about to be raised, the attendant at the bottom of the mine shaft moves the sliding wedge so as to cause the paus to engage with the ratchet wheels, when the skip or cage can be raised without risk of accident on the breaking of the chain or rope. Instead of using paus for preventing the rotation of the toothed wheels, a slide having teeth on either side may be employed for that purpose. *Patent completed.*

3209 J. H. GURATLE. *Improvements in rotary and other brushes.* Dated December 24, 1864.

In constructing rotary brushes for sweeping streets, floors, and other surfaces, the inventor secures the base, fibre, or bristle by compressing it near its middle between parallel surfaces. He prefers to make a rotary brush with four equi-distant radial series of tufts or bundles of base, fibre, or bristle, which he secures between parallel surfaces in the following manner:—The tufts or bundles he employs are of a length equal to the diameter of the rotary brush to be made, and cross each other at their middle, the two series of tufts or bundles thus crossing each other making four radial rows of tufts or bundles. The tufts or bundles situated in one plane alternate with the tufts or bundles situated in a plane at right angles thereto, and the whole are held together by means of bars of angle iron. Four bars of angle iron having a length equal to the brush are taken, and are placed in the four angles formed by the crossing of the tufts or bundles, the said bars of angle iron fitting in the said angles. By this arrangement each of the four series of tufts or bundles is enclosed between two parallel plates constituting the sides of the angle iron, and by means of screws passed through the angle iron and nuts screwing on the ends of the said screws, the four bars of angle iron are bound together firmly, and the tufts or bundles of base, fibre, or bristle held securely between them. The brush is provided with centres at its ends which turn in a frame, the latter being supported on a pair of wheels on which the brush is propelled or drawn along. By means of toothed gearing the rotary motion of the last described wheels is transmitted to the brush, so that, on drawing or propelling the brush along, it is made to rotate and to sweep the surface over which it is drawn or propelled. *Patent abandoned.*

3210 T. WHITLEY and J. JOWETT. *Improvements in machinery used in combing wool and other fibrous materials.* Dated December 24, 1864.

For the purposes of this invention two endless, and, by preference, circular travelling combs are used, one within the other, the position of the axes of which do not coincide but are arranged in such a manner as to cause the inner endless travelling comb to come in contact with the outer endless travelling comb at one point where the feeding of the wool or fibrous materials into the two combs takes place. It should, however, be stated that the arranging two endless travelling combs, as above explained, is well known and in use. With these two endless travelling combs reciprocating feeding heads are employed, using by preference two feeding heads, one exterior of the larger travelling comb and the other interior of the smaller travelling comb. The two reciprocating feeding heads are opposite each other, and are connected together so that when by their reciprocating action one of the feeding heads is moving away from the travelling combs, the other is moving up to the travelling combs. These feeding heads work in the locality where the two travelling combs come together, and the travelling combs act as one receiving comb where the feeding takes place. The feeding heads employed are of a class which is well known, they being arranged in such manner as not only to feed wool or other fibres into the travelling combs but also to comb out the projecting fringe of fibres projecting from the teeth of the travelling combs, and also from the teeth of the combs of the feeding heads, such fringes being produced by the separation of the feeding heads from the travelling combs. Drawing apparatus or rollers are applied to draw off alivers on both sides of each of the travelling combs; hence there will be at least four alivers drawn from the two travelling combs; but, if desired, there may be more than two alivers drawn from each comb, as has heretofore been the practice in some machines. The wool, as heretofore, is removed from each of the travelling combs after the alivers have been drawn off, and before the two travelling combs come together where the feeding takes place. *Patent completed.*

3211 J. F. ROBERTSON. *An improved connector applicable to bales used in cavalry stables and for other purposes.* Dated December 24, 1864.

The patentee claims, firstly, the adaptation and application to bales used in the cavalry stables of connectors composed of two links respectively formed as described at the ends which are brought together, such ends being secured against lateral displacement, as required, by a covering ring or hollow ball, as described. Secondly, the use of such connectors, either vertically or horizontally, for other purposes, as described. *Patent completed.*

3212 J. PARKINSON. *Improvements in lamps for railway carriages.* Dated December 24, 1864.

In performing this invention the inventor places in a tube above the lamp, lying in the direction of the

length of the carriage, two valves, fixed on the same spindle, one of which is at all times closed by the resistance of the air due to the speed of the carriage, or by the force of the wind, while the other remains freely open for admitting the air to the lamp; the spindle of these two valves is suspended from the middle to obviate all friction. Another part of the invention consists in preventing the downward current of gusts of wind by means of a ventilating hood, to the spindle of which are fixed vanes revolving in the chimney of the lamp. *Patent abandoned.*

3213 J. WOLSTENHOLME. *An improved implement for cutting pipes and bars of metal.* Dated December 28, 1864.

This invention consists in the casting of pipes or bars of metal by means of a circular cutter revolving in a brush which slides on a hooked piece of steel or other metal. The pipe or bar to be cut is securely held in a vice or otherwise, and the circumference of the cutter is brought against the pipe or bar by means of a screw passing through the lower end of the hooked piece above referred to; the implement is then turned round by the handle forming the continuation of the screw, and the cutter is set up by the turning of the screw; by this means the cutter gradually penetrates into the metal until the pipe is cut asunder, or the metal bar is sufficiently indented to enable it to be broken. *Patent completed.*

3214 H. HICKLIN and O. PARDOX. *Improvements in the construction of coke ovens.* Dated December 27, 1864.

This invention consists in constructing coke ovens with one or more main flues passing over the top of a series or group of two or more ovens, and communicating with one or more main flues, constructed underneath the floors at the bottoms of the ovens, and into which system of flues openings are made through the tops of the ovens, which openings may or may not be made capable of being regulated or stopped, as may be required. The bottom flues communicate with a chimney. By this construction the patentees cause the flame and gases to mix together, and the heated gaseous currents from each oven to pass over or under, or both over and under, itself and every other oven in the group or series, whereby a much greater and much more uniform heat, and consequently a larger and better produce of coke, will be obtained than heretofore. *Patent completed.*

3215 W. E. GEDER. *An improved apparatus for administering douches and injections with continuous and continual jet.* (A communication.) Dated December 27, 1864.

This invention is not described apart from the drawings. *Patent completed.*

3216 G. ALTON. *New or improved machinery for flanging plates and strips of metal.* Dated December 27, 1864.

The main object of the present invention is to bend boiler plates after they have been flanged to the curve necessary for the body of the boiler to be made. The invention is applicable to bending plates after they have been flanged to any curve, and for any purpose required. The invention consists in heating plates after having been flanged by machinery according to another invention for which the patentee has obtained letters patent of even date herewith, or after having been flanged by hand, and in passing such flanged plate through rolls, in the upper or lower of which he forms a channel or annular groove for the flange on the plate to rest in. In order to suit different thicknesses of flanges he employs collars or "gluts" on the rolls, by the addition, or removal, or sliding of which the extent or size of the groove may be regulated. In order to use the rolls as ordinary rolls when not required for flanging plates, he fills up the grooves with segmental blocks, so as to give the rolls an even surface throughout. *Patent completed.*

3217 G. ALTON. *A new method of, and machinery for, curving flanged boiler and other metal plates.* Dated December 27, 1864.

This invention for flanging plates consists of machinery constructed as hereinafter described. The machine is composed of two main parts, the one stationary and the other movable. The stationary part is a table or block carrying clamps for the purpose of receiving the plate or strip of metal to be flanged, and of securing it on the block. The movable part consists of a frame carrying one, two, or more rollers made to revolve so as to bring the rollers parallel to the edge of the plate to be flanged. The frame is also free to advance towards and recede from the block as required. Or the movable part consists of one roller, the axes of which are carried by blocks free to move up and down and to and fro in heads provided for the purpose. Again, instead of a roller, the patentee sometimes uses a pressing cam. Supposing a plate to require to be flanged and curved, say, for instance, for the body of a locomotive boiler, the plate is placed in a furnace and, at a proper heat, is withdrawn and placed upon the block, where it is securely held by the clamps, the edge projecting over the block to the extent necessary for the flange required. The movable roller machine, of one or other kind before mentioned, is caused to approach and bend down the edge so as to flange it against the side of the block; the plate thus flanged may then be taken to a curving or bending machine (the subject of letters patent granted to the patentee of even date herewith) consisting of rolls similar to those ordinarily used for rolling metals, but with a part or parts removed so as to form a space in which the flange enters, while the surface of the rolls acts upon the body of the plate; the plate issues from the rolls flanged and bent to the curve required. *Patent completed.*

3218 W. BUTTRICK. *Improvements in the means of signalling between the passengers and the guard and driver of railway trains.* Dated December 27, 1864.

In signalling on railway trains according to this invention the inventor employs a lamp which he uses also to light the compartment of the carriages; this lamp he mounts on a stem, enclosed with partitions separating the compartments of the carriages, a suitable opening being made at the upper part for the introduction of the lamp, somewhat as in ordinary; the stem is furnished with a rack having in gear with it a toothed pinion, by moving the axis of which the stem and lamp may be raised at pleasure by a passenger and projected through the roof of the carriage, and it then becomes a signal to the guard or engine driver. He paints the top part of the lamp red, or he makes it otherwise conspicuous, so as to be readily seen by day light, while the light will serve the same purpose in the dark. *Patent abandoned.*

3219 J. DODGE. *Improvements in apparatus for rolling, shaping, and forging "file blanks," "flyers," and other metallic articles of small dimensions.* Dated December 28, 1864.

This invention relates to a novel construction of self-acting mechanism for rolling and forging small articles of

metal so arranged that the various operations may be effected in one machine. The improvements consist in the combination and use of a pair of rollers with dies or matrices when required for rolling the metal, and a pair of jaws or levers for forging; the lower roller is furnished with tappets or lifters which act upon the movable lever or jaw of the pair of jaws for forging or pressing the metal, the whole being operated by gearing. The power is communicated to the rolls by means of a clutch-box, having steel-faced clutches and worked by levers actuated by a treadle. The upper roller is furnished with a swell or cam which, at a certain part of the revolution, lifts the bolt that raises the clutch-box lever and throws the clutch out of gear, and simultaneously a projection on the same roller comes into contact with a short arm or stop and effects the instantaneous stoppage of the rollers. This takes place at every entire revolution of the rollers, so that the attendant has sufficient time to adjust the metal and to place it properly under the rollers or jaws. The operator places his foot on the treadle and withdraws the short arm and bolt; the latter releases a spring which forces the clutch-box into gear and starts the machine. The second part of the invention relates to a novel method of regulating the distance between the rollers, and consists in the use of two wedges which are inserted in the pedestals above the bearings of the top roller, and are moved nearer to or further from each other by a right and left-handed screw, which is provided with a collar that is held by snugs in a central block; by turning this screw, the wedges are moved and increase or decrease the distance between the rolls. The steps of the top roller are held up so as to bear against the wedges by means of springs inserted between the steps of the roller. *Patent completed.*

3220 H. JOHNSON. *Improvements in the manufacture of top notches and runners for umbrellas and parasols.* Dated December 28, 1864.

This invention consists in raising top notches and runners for umbrellas and parasols from sheet metal by dies and pressure. *Patent completed.*

3221 J. CLEAVER. *Improvements in the manufacture of Portland cement.* Dated December 28, 1864.

The mud that is deposited on the banks or borders of different rivers varies in its composition, and is only in a few instances originally adapted for the manufacture of Portland cement, in consequence of the deficiency of silica. The patentee causes the deposit or mud intended to be used to be carefully analysed, and having ascertained the relative proportions of the silica and alumina, he causes to be added to the deposit or mud that is to be analysed so much silica (either in a soluble or insoluble state) as will form a mixture of the following proportions:—Silica, 60 or 65 per cent., and alumina 35 or 30 per cent., upon every ton of the mixture, and which mixture will then be applicable to the manufacture of Portland cement. *Patent completed.*

3222 J. R. BRACKEN and R. DIXON. *Improvements in the construction of coke ovens.* Dated December 28, 1864.

The nature of this invention consists in constructing coke ovens with one, two, or more flues, for the purpose of conveying the gases when in a state of combustion underneath the floor and around the inner casing of the coke ovens. The flues communicate with the interior of the oven, and the gases produced by the coals are conveyed through them under the floor and around the inner casing of the oven, and afterwards into chimneys. *Patent completed.*

3223 A. P. BLANCHET. *Improvements in the application of steam power to the cultivation of land.* Dated December 28, 1864.

We cannot here give space to the details of this invention. *Patent completed.*

3224 J. BARDIES. *Certain improvements in the manufacture of pianos.* Dated December 28, 1864.

This invention consists in constructing pianos so as to prevent the atmosphere having any injurious effect on them, either by damaging the glued joints, or in any way interfering with the tone of the instrument. The inventor surrounds the board of the rest pins, and also that of the hitch pins, with iron, and connects the two boards by means of iron bars conveniently fixed by means of screws and bolts. The sounding board is glued on one side only; the other side is fixed by screws, which allow for the swelling which takes place in very damp places. *Patent abandoned.*

3225 J. and W. THORNTON. *Improvements in machinery for producing looped fabrics.* Dated December 28, 1864.

For the purposes of this invention needles or hooks with hinged bits or beards are preferred to be used. Each needle is arranged to be capable of making a rotation, or partial rotation, so as to cause it to work and produce loops in different positions, that is, in two positions opposite to each other. These needles or hooks are preferred to be set round a circle, and to slide in grooves so as to knock over the work. A thread carrier is used to supply thread in each of the positions assumed by the needles or hooks in working. The needles or hooks as they receive a thread from one of the thread carriers when in one position work the course in a similar manner to that in which like needles work a course in machines where no rotation is given to the needles or hooks. Then the needles or hooks make a half rotation on their axis, and present their beards in the opposite direction, and receive thread from another thread carrier and work another course, and so on, making a half rotation for each course. It is preferred that each needle or hook should have a screw thread on its stem as the means of obtaining the turning action, but other arrangements may be made for turning the needles. *Patent completed.*

3226 W. HOLMS. *Improvements in the mode of treating warp yarns used for weaving, and in the machinery or apparatus connected therewith.* Dated December 28, 1864.

The warp yarn, according to this invention, is placed on a beam or beams, and at one process it is dyed and dressed or stiffened; or, should it not require to be dressed or stiffened, the dressing process is effected alone. These operations are capable of being carried out in several ways. According to one modification, the beam or beams upon which the warp yarns are wound previous to being dressed, instead of being placed near to the trough that contains the dressing or stiffening material, as in the ordinary dressing machine, are situated at a greater distance from it. Intervening between such beams and the dressing machine is placed a framework carrying a vat or vats, in which is placed the colouring matter for dyeing the thread; the framing containing the dye vat or vats may be made in one piece with the framing of an ordinary dressing machine, or it may be separate, as may be found most convenient. Within the

dye vat or vats there are situated one or more carrying rollers, over or under which the threads of the warp pass as they are wound on to the weaver's beam; passing from the dye vat or vats the threads are conducted over heated cylinders, or heated currents are impelled against them by fanners, so as to drive off the moisture arising from the dyeing process, and thus drying them. After being dried they pass through the trough containing the stiffening or dressing solution, the remaining part of the process being similar to that used in the ordinary dressing machines. *Patent abandoned.*

3227 W. H. FRENCH and A. BEDBOROUGH. *Improved apparatus for signalling in railway trains.* Dated December 28, 1864.

In carrying out this invention the patentees employ electric currents obtained from suitable batteries for operating an ordinary trembling bell mounted on the engine-tender and in every guard's van in the train. The passenger carriages they fit at each side with semaphore signals, which will fall by their own gravity, and thereby indicate whence the signal, if it be one transmitted by a passenger, has emanated. *Patent completed.*

3228 R. H. LEEKE. *New machinery for cutting at one operation dovetail and mitre joints.* (A communication.) Dated December 29, 1864.

This invention relates to the forming of dovetail grooves and tongues running along the united edges of two pieces of wood to be jointed together, and consists in the construction of machinery for this purpose, so arranged that the mitre edges of the two pieces of wood or other material and the dovetail groove in the one edge and the dovetail tongue upon the other edge, are all formed at one and the same operation by a series of cutting tools made to act consecutively upon the wood, without its being requisite for that purpose to shift either the piece or pieces of wood acted upon, or the cutting tools. The invention also consists in separating the wood if in one piece by the act of forming the dovetail mitres, thereby rendering it unnecessary to saw asunder previously the pieces of wood on which the dovetail mitres are to be formed, and, consequently avoiding the time and cost of such sawing. *Patent completed.*

3229 J. D. MORRISON. *Improvements in painless dentistry.* Dated December 29, 1864.

This invention consists in apparatus for cooling and tempering air and applying it as an anæsthetic agent by means of the forceps, or other instrument used, bringing the tooth or gums into the anæsthetic condition by reducing them to a nice but rapid graduation from blood heat to insensibility, and after the dental operation, by a like graduation, restoring them from insensibility to blood heat, and which instrument, besides being the anæsthetic channel, is itself continuously and immediately the instrument for extracting the tooth. *Patent completed.*

3230 G. EDWARDS. *Improvements in pneumatic apparatus for raising materials and other purposes.* Dated December 29, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

3231 D. SUTHERLAND. *Improvements in preparing charges for, and in charging, ordnance.* Dated December 29, 1864.

The object of this invention is so to prepare charges of explosive material for ordnance purposes that the useful effect of the gas evolved from the ignition for the conveyance of mechanical force to a projectile may be economized to as great an extent as possible, while the damaging or destructive effects upon ordnance of the sudden conversion of solid explosive material into gas may be modified, and the strain upon the gun diminished. This is effected in the following manner:—The explosive material (which it is preferred should be compressed gunpowder or gun cotton) is surrounded by or enclosed within, by preference, a hollow cylinder composed of wood, or some material or materials of sufficient dimensions in relation to the bore, and sufficiently compressible in their nature to receive and deaden and thus neutralize the sudden bursting effect or action of the gas. *Patent completed.*

3232 J. MILLAR. *Improvements in locomotive steam engines, and in part applicable to other engines.* Dated December 29, 1864.

It is the object of a part of this invention to distribute the weight of the locomotive in such a way that a larger portion of it than is usual bears upon the driving wheels, the axle of which is situated immediately forward of the fire-box, according to a common arrangement. The steam cylinders are placed forward of, but as near as possible to, the driving wheels, their piston rods working out at their front or back ends, and acting on the crank pins through return connecting rods. There may be two cylinders on each side with the connecting rod in each case working between them; or there may be one cylinder only on each side, with double forked or bow connecting rods. *Patent completed.*

3233 M. A. MUIR and J. M'ILWHAM. *Improvements in and relating to fastenings for railways.* Dated December 29, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

3234 J. and W. TRUSWELL. *An improved float for indicating the level of the water in steam boilers.* Dated December 29, 1864.

By the use of this improved float the inventors are enabled to have a difference in the weight of more than twenty pounds, and hence the liability to stick is greatly reduced, if not rendered altogether impossible. The improved float is composed of two parts—namely, a heavy brick tile, and a hollow inverted vessel placed above it, being fixed to the same rod. The latter is in the form of a shallow inverted vessel rather less than the tile, being open beneath, and having a small space all round between its lower edges and the upper surface of the tile to admit steam into the vessel. The weight of this float is about 72 lbs. against a counterbalance weight of only 50 lbs. outside the boiler. The action of the float is as follows:—When the level of the water in the boiler falls, it will be evident that the superior weight (72 lbs.) of the float will cause it to sink also, and by raising the counterbalance weight will indicate danger; but as soon as the level of the water begins to rise, it closes the aperture all round between the tile and the upper vessel, and the steam contained in the latter renders it buoyant, and thus counteracting the superior weight of the float compels it to rise with the ascending level of the water, and allow the counterbalance weight outside the boiler to fall, and thus the rising or falling level of the water in the boiler will at all times be indicated with unerring accuracy. *Patent abandoned.*

3235 S. SAVILLE. *Improvements in separating wool from refuse, mixed fabrics, and materials.* Dated December 29, 1864.

This invention consists in submitting mixed fabrics or materials containing wool to the joint action of an acid and an alkali, or salts of an alkali, or alkaline earth. One method the inventor adopts is to immerse the fabric or material in sulphuric acid, to which potash is added; or he replaces the sulphuric acid by muriatic acid. According to another part of the invention he steeps the materials in a heated solution of alum. By these processes cotton or other vegetable fibre may be beaten out when in a dry state, leaving the wool in a suitable condition for the usual processes of the woollen manufacture. *Patent abandoned.*

3236 T. R. HARDING. *Improvements in apparatus for the manufacture of pins and buckles, or gills.* Dated December 29, 1864.

This invention relates, in the first place, to an improved mode of feeding wires, or pins into pointing, cutting, or other machines used in the manufacture of pins or buckles. Secondly, to an improved mode of fastening pins or wires, and cutting them off at the required lengths. *Patent completed.*

3237 J. DODD. *Improvements in mules for spinning and doubling.* Dated December 22, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

PROVISIONAL PROTECTIONS.

Dated March 3, 1865.

600 J. Spence, Liverpool, merchant. *Improvements in apparatus for operating engineers' and carpenters' tools by hand or other power.* (A communication.)

Dated March 19, 1865.

758 G. Ralston, Tokenhouse-yard, City. *Improvements in the mode of forming and making clothing.* (A communication.)

Dated May 15, 1865.

1349 H. A. Bonnerville, Porchester-terrace, Bayswater. *Improvements in hydrometers for ascertaining the strength of spirits, and the specific gravity of fluids.* (A communication.)

Dated May 22, 1865.

1403 A. G. Bignio, Boulevard de Strasbourg, Paris, merchant. A new kind of casing intended to protect the stock and lock of fire-arms, with guiding caps to take aim.

Dated May 30, 1865.

1488 L. Martin, Blackbar n, Lancashire, engineer and millwright. An improved method and apparatus for moulding wheels.

Dated June 8, 1865.

1563 S. B. Tucker, Threadneedle-street, merchant. *Improvements in calorific or heated air engines.* (A communication.)

Dated June 9, 1865.

1569 J. G. T., and F. R. Holmes, Norwich, agricultural engineers. *Improvements in horse hoes and drills.*

1576 J. Baker, M.A., Lieut.-Col., Croft Lodge, Cambridge. *Improvements in machinery for obtaining power when fluid pressure is employed.*

Dated June 10, 1865.

1579 J. M. Dentith, Connaught's Quay, Flintshire. *Certain improvements in the manufacture and production of chromate and bichromate of potash, employed in dyeing and printing woven fabrics.*

1583 D. Spink, South-road, Weston-super-Mare, Somersetshire. *Improvements in propelling vessels.*

Dated June 15, 1865.

1615 S. Heleman, Ryder's-court, Leicester-square. An improved arrangement for fastening shirts, collars, and other articles of wearing apparel by which the ordinary button or stud is dispensed with.

1616 S. Heleman, Ryder's-court, Leicester-square. An improved description of stool for fastening shirts, cuffs, waistcoats, and other articles of wearing apparel.

1617 J. F. Dubois, Rue de la Butte Chaumont, Paris. An improved bit for subduing or stopping runaway or restive horses.

1621 W. Clark, Chancery-lane, engineer. *Improvements in apparatus for preventing collisions and other accidents on railways.* (A communication.)

1625 J. Hartley, Oley, Yorkshire. *Improvements in corn screens.*

Dated June 16, 1865.

1627 W. E. Gedge, Wellington-street, Strand. An improved method of and apparatus for manufacturing pottery. (A communication.)

1629 R. A. Brooman, Fleet-street, patent agent. *Improvements in the manufacture or shaping of iron intended for the shoes of horses and other animals, and in machinery employed therein.* (A communication.)

1630 R. A. Brooman, Fleet-street, patent agent. *Improvements in watches and other time-keepers.* (A communication.)

1631 J. H. Johnson, Lincoln's-inn-fields. *Improvements in lamp burners and parts connected therewith.* (A communication.)

1633 W. T. Wanklyn, Manchester. *Improvements in silk winding machines, part of the said improvements being also applicable to cleaning and doubling machines.*

Dated June 17, 1865.

1635 H. E. Clifton, Liverpool. *Improvements in apparatus for "lap" and "surface shaving" the splitting and beveling of leather and other like substances in sheets and strips.*

1638 A. Klein, De Keyser's Hotel, Bridge-street, Blackfriars. *Improvements in gunpowder for mining and war purposes.* (A communication.)

1639 G. Payne, Belmont Works, Battersea, chemist. *Improvements in purifying cotton seed oil.*

1639 T. R. Orampton, Great George-street, Westminster, civil engineer. *Improvements in the construction of roadways, floorings, or other surfaces.*

Dated June 19, 1865.

1643 H. Defries, Houndsditch, manufacturer. *Enabling the guards of railway trains to pass from one part of a railway train to another.*

1647 J. H. Johnson, Lincoln's-inn-fields. *Improved preparations for the treatment and preservation of the hair.* (A communication.)

1648 W. Clay, Liverpool, iron manufacturer. *Improvements in ventilating railway carriages, and in the apparatus to be employed therefor.*

Dated June 20, 1865.

1650 G. Clark, Napier-street, Dover-road, Borough. *Improvements in envelopes or wrappers for covering, packing, and protecting bottles, jars, or other fragile articles, and in apparatus for manufacturing the same.*

1651 A. Colley, Enfield Highway. *Improvements applicable to breech-loading fire-arms.*

1652 W. E. Gedge, Wellington-street, Strand. An improved elastic mattress or spring bed. (A communication.)

1658 J. Scholl, Berwick-street, Soho. *Improvements in gas burners.*

1659 W. Hanson, Truman-street, Great Alfred-street, Nottingham, engineer. *Improvements in apparatus applied to railway carriages to enable the passengers in a train to communicate with the guard and engine driver thereof.*

1660 M. Audinwood, jun., Weston-upon-Trent, Derby, farmer. *Improvements in reaping and mowing machines.*

1661 D. M'Glasham, jun., Glasgow. *Improvements in sewing machines, and in the machinery or apparatus connected therewith.*

1662 E. Vignier, Great Tower-street, cognac brandy merchant. *Improvements in distilling and rectifying, and in the apparatus employed therein, parts of which improvements are applicable to steam generators.*

1663 E. Dupont, Fayt Ironworks, Belgium, iron master. *An improved system of wheels for railway carriages.*

Dated June 21, 1865.

1667 M. Henry, Fleet-street. *Improvements in apparatus for measuring fluids.* (A communication.)

1668 O. H. Gardner, West Harding-street, Fetter-lane, manufacturer. *Improvements in apparatus for polishing, smoothing, or facing, especially applicable to lithographic stones.*

1669 C. T. Porter, Manchester, engineer. *Improvements in surface condensers for steam engines, and in feeding boilers therefrom.*

1670 W. C. Rickman, Lithanger, Emdshot, Southamptonshire. *Improvements in the rigging of sailing boats and vessels.*

LIST OF SEALED PATENTS.

- Sealed July 8, 1865.
- | | |
|---------------------------------|--|
| 78 A. and M. Meyer | 134 J. Marshall |
| 85 W. E. Gedge | 137 J. Bettelcy |
| 86 W. E. Gedge | 140 R. A. Brooman |
| 88 R. A. Brooman | 141 F. H. Lakin |
| 89 E. T. Hughes | 144 C. T. Jenkins |
| 102 R. A. Brooman | 148 F. P. H. Cahuzac |
| 104 G. Gaze | 199 T. Brown |
| 110 W. S. Longridge and J. Mash | 230 C. Falck |
| 112 A. J. Sax | 239 J. Southall, jun., and H. Southall |
| 114 J. Weeks | 263 F. A. Laurent and J. Castelaz |
| 115 W. Agar | 314 W. Clark |
| 117 W. Wilkins | 413 G. Harton |
| 118 A. and E. Paul | 790 R. J. Galling |
| 125 T. Bourne | 882 J. G. Jones |
| 130 J. B. Farrar and J. Hirst | 892 T. Wilkes |

Sealed July 11, 1865.

160 M. B. Mason	410 J. Gresham
163 G. F. Bradbury	447 W. E. Newton
174 L. Balma	635 W. T. Hamilton
176 B. F. Stevens	769 S. S. Gray
216 O. G. Sell	771 J. T. Romminger
231 W. Creasy	775 A. G. Browning
232 G. Dibley	1051 H. Leonhardt
241 J. Combe	

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the *London Gazette*, July 11, 1865.

544 H. H. Hanson. Railway chairs.

550 T. W. Roys and G. A. Lillendahl. Rocket-guns.

551 R. Barclay. Sewing machines.

555 G. T. Ellwick. Baking biscuits.

567 S. Whiting. Shop counters.

571 J. Young. Distilling bituminous substances.

573 W. Holiday. Presses.

577 J. Dodd. Spinning mules.

579 A. T. Godfrey. Musical instruments.

580 T. Horton and D. S. Price. Products obtained in smelting iron.

581 J. Park. Paper.

592 R. Johnson. Strained wire fences.

597 D. and J. Maxwell. Driving piles.

606 J. H. Johnson. Stopping bottles. (A communication.)

607 J. H. Johnson. Steam generators. (A communication.)

612 W. Clulow. Sheep shears.

614 F. Cruickshank. Coating ships.

633 E. W. Young. Bridges.

634 R. A. Brooman. Tubular boilers. (A communication.)

636 L. Perkins. Cooling atmospheric air.

643 M. Mergaus. Converting cast iron into wrought iron.

657 R. Mushet. Homogeneous iron.

659 W. Clark. Revolving fire-arms. (A communication.)

704 W. Clark. Holding lamp shades. (A communication.)

736 J. Ramshotom. Rolling metals.

743 A. V. Newton. Steam generators. (A communication.)

806 M. Morgans. Refining iron and steel.

871 J. C. C. Halkett. Paints for coating vessels.

908 J. Poole and T. Brown. Feet protectors.

1045 J. M. Hart. Locking arrangements for safes.

1247 G. Redrup. Cutting cylindrical articles.

1249 J. Hampton. Refrigerator and condenser.

1390 C. and S. A. Varley. Telegraph supports.

1559 W. Sim and A. Barff. Generating heat.

1560 J. Ferguson and R. Miller. Steel.

1568 G. Haseltine. Sifting flour. (A communication.)

1569 J. G. T., and F. R. Holmes. Horse-shoes.

1572 G. Haseltine. Sewing machines. (A communication.)

1595 G. Haseltine. Shells for ordnance. (A communication.)

1678 G. Haseltine. Sewing machines. (A communication.)

The full titles of the patents in the above list can be ascertained by referring back to their numbers in the list of provisional protections previously published.

Opposition can be entered to the granting of a patent to any of the parties in the above list who have given notice of their intention to proceed, within twenty-one days from the date of the *Gazette* in which the notice appears, by leaving at the Commissioners' office particulars in writing of the objection to the application.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

- | | |
|------------------------|--------------------------------|
| 1973 A. Gilbar | 2027 R. Ridley and J. G. Jones |
| 1975 J. Rhoads | 2028 A. Leslie |
| 2014 W. E. Cochrane | 2062 A. Cotelle |
| 2023 P. A. L. Canonica | |

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

- | | |
|-------------------|------------------|
| 1497 T. Restell | 1538 P. R. Hodge |
| 1528 J. D. Weston | |

LIST OF SPECIFICATIONS PUBLISHED, For the Week ending July 8, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	
s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		
2025	1	42042	0	42653	0	42064	2	0	2075	0	42085	0
2030	0	42043	0	42054	0	42065	0	42076	0	42086	0	
2031	0	42044	0	102055	0	42066	0	42077	0	42087	0	
2034	0	42045	0	42056	0	42067	2	0	2078	0	42090	0
2035	0	42046	0	62057	0	102068	0	42079	0	102091	0	
2036	0	102047	0	42058	0	42069	0	42080	0	42092	0	
2037	0	42048	1	62059	1	02070	0	82081	0	62093	0	
2038	0	42049	0	82060	0	42071	1	82082	0	102094	0	
2039	0	42050	0	102061	0	102072	0	102083	0	42097	0	
2040	1	42051	0	82062	0	102073	0	42084	0	42099	0	
2041	0	82052	0	42063	0							

NOTE.—Specifications will be forwarded by post from the Great Seal Patent Office (publishing department) on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post Office Order, made payable at the Post Office, High Holborn, to Mr. Bennett Woodcroft, Great Seal Patent Office, 25, Southampton-buildings, Chancery-lane.

LATEST PRICES OF MATERIALS USED IN CONSTRUCTION.

TIMBER, duty 1s. per load, drawback 1s.

Teak -	load £12 0	£13 10	Archangel, yellow -	£13 10	£14 10
Quebec, red pine -	3 10	4 15	St. Petersburg, do. -	11 0	13 0
St. John, N.B., yellow -	0 0	0 13	White -	8 0	10 0
Quebec oak, white -	0 5	0 6	Dothenburg, yellow -	10 0	11 0
" birch -	2 10	4 10	" white -	9 0	10 0
" elm -	3 10	5 0	Goffe, yellow -	10 10	11 0
Danish oak -	3 5	0 6	Solofman -	9 10	11 0
" fir -	2 15	3 10	Charkonia, per C. -		
Meisel fir -	3 10	4 0	1st, by 3 by 9 in.		
Riga -	3 5	5 10	Yankow -	18 0	23 0
Swedish -	2 10	3 10	Dozal bank, Danzig, -		
Masts, Quebec red pine -	6 10	8 10	St. Petersburg -	0 14	1 8
" yellow pine -	5 0	6 0	Fusion Stone per ton -	5 0	5 0
Lathwood, Danzig, fir -	7 10	8 0	Oil, -		
" St. Petersburg -	8 10	9 10	Seal, pale -	pr ton	40 0 0
Deals, per C., 12 ft. by 3 by 9 in., duty 2s. per load, drawback 2s. -			Sperma body -	90 0 0	
" do -			Cod -	80 0 0	
White, Nth Sea, pale -			Whale, Nth Sea, pale -	41 0 0	
Quebec, white spruce -	10 15	0 15	Olives, Gallipoli -	54 0 0	
St. John -	13 10	0 10	Cocconut, Cochon -	41 10	45 0
Yellow pine, per reduced C. -			Palm, fine -	37 0 0	
Canada, 1st quality -	18 0	20 0	Unseeded -	32 5 0	
" 2nd -	13 0	14 10	Unseeded, Eng. pale -	44 10	5 0
			Unseeded -	27 15	25 0

METALS.

IRON:—

Welsh Bars, in London -	per ton	7 15 0	to 8 0 0	24
Nail Rods -	do	8 0 0	9 0 0	
Hoops -	do	9 15 0	10 0 0	
Sheets, single -	do	10 10 0	11 0 0	
Staffordshire Bars -	do	3 15 0	4 0 0	
Casts, in Wales -	do	7 0 0	7 5 0	
Rails -	do	7 0 0	7 5 0	note
Foundry Pig, at Glasg, No 1 -	do	2 15 0	3 3 0	note
Swedish Bars -	do	12 0 0	12 10 0	24

STEEL:—

Swedish Keg, hammered -	do	15 0 0	0 0 0	
Swedish Piggot -	do	16 0 0	0 0 0	

COPPER:—

Sheet & Sheathing, & Bolts -	per ton	91 0 0	0 0 0	3
Hammered Bottoms -	do	101 0 0	0 0 0	
Flat Bottoms, not Hamrd -	do	17 0 0	0 0 0	
Cake and Tough Ingot -	do	88 0 0	87 0 0	
Best Selected -	do	85 0 0	84 0 0	
Fine Foreign Copper -	do	92 0 0	0 0 0	
Yel. Metal Sheathing & Rods -	per lb.	0 0 7 1/2	0 0 8	

LEAD:—

Pig, English -	per ton	19 0 0	21 0 0	24
" Spanish Soft -	do	18 10 0	19 0 0	
Shot, Patent -	do	22 10 0	0 0 0	
Sheet -	do	20 10 0	0 0 0	
White -	do	26 0 0	26 10 0	

TIN:—

English Block -	per cwt.	9s 0d	0s 0d	24
do Bar -	do	9s 0d	0s 0d	
do Rolled -	do	9s 0d	0s 0d	
Bars -	do	9s 0d	0s 0d	
Strais -	do	9s 0d	9s 0d	note

TIN PLATES:—

Best Charcoal, I.C. -	per box	1 8 6	1 9 6	
Second Quality -	do	1 6 6	1 7 6	
Cases -	do	1 5 0	1 3 6	

SPELTER:—

On the spot -	do	21 10 0	0 0 0	note
---------------	----	---------	-------	------

ZINC:—

English Sheet -	do	27 10 0	28 0 0	24
Quicksilver -	per bu.	8 0 0	0 0 3	

FRENCH & SMITH, Sworn Brokers
Branbant-court, Philpot-lane, E.C.; and
4, Bumpford-place, Liverpool.

MECHANICS' MAGAZINE.

LONDON: FRIDAY, JULY 21, 1865.

THE ATLANTIC TELEGRAPH.

ONCE more the enterprising band to whom is committed the task of uniting Europe and America by electric telegraph, are approaching the critical period of their great work. The wondrous cable which, during ten months, has been steadily increasing in length until its growth was stopped at the two thousand three hundredth nautical mile, is now about to be unwound from the great water-tanks in which it has been coiled and preserved on board the "Great Eastern," and committed in hope to its final resting-place at the bottom of the Atlantic.

It may not be uninteresting to trace briefly the progress of the present cable. The contract for its manufacture was entered into in May, 1864, and the production of the "core," consisting of the copper and gutta-percha portion of the work, commenced immediately at the Wharf-road under the prompt and energetic management of Mr. Chatterton, assisted by Mr. Willoughby Smith, the experienced electrician of the Gutta-percha Works. At the Finishing Works, at Greenwich, owing to the necessity for remodelling the whole of the machinery and appurtenances to meet the improvements required by modern experience, it was not until September 2nd that the first covering machine was set to work. By the 6th of December seven covering machines, the most ever going at one time during the manufacture of this cable, were fully got into work. The cable completed up to December 31st, 1864, was 768 nautical miles, and the entire cable, of which the total length is 2,300 nautical miles, was finally completed on the 10th of June last. The greatest amount of cable completed during any one week of its progress was 95·4 miles, which was turned out by seven machines during the week ending February 25th, 1865. The average rate of manufacture per day during the whole period from its commencement at Greenwich was 10·2 miles. We have already given in these columns a full description of the cable itself and of the machinery with which its final covering was effected.

The "Great Eastern" steamship, which has now entered upon a new, and, let us trust, a more prosperous epoch in her career by her association with a sister enterprise of even greater magnitude and moment than her own, commenced her present engagement in June, 1864, and arrived at her berth in the Medway on the 11th July in that year. Between that time and the middle of February were erected in her the three enormous tanks of iron, each about 59 ft. diameter by 20 ft. in depth. These huge receptacles now contain the whole cable and sufficient water to keep it all submerged. The shore ends being separately manufactured are not shipped on board the "Great Eastern." The coiling of the cable into the "Great Eastern" tanks commenced on the 20th January in the present year, the cable being drawn on board by a small engine and hauling gear.

The cable was brought down to the "Great Eastern" in nine separate trips by two Government hulks, the "Amethyst" and "Iris," each fitted like the "Great Eastern" with water-tight tanks, in which, during coiling and transit, the cable was kept submerged. The average rate at which the cable was shipped on board these hulks at Greenwich was 22·6 miles per day; while the average rate of transhipment from the hulks into the "Great Eastern" tanks was 22·7 miles per day. The weight of cable shipped on board the "Great Eastern" is about 4,100 tons, and

if to this be added the coals, 8,500 tons, the stores, machinery, and human freight, we shall arrive at a total burden at present on board that vessel of little less than 20,000 tons. The individuals on board number nearly 500, of whom, however, only 115 are officers and seamen, the large number of 179 stokers and ship's enginemens being required to attend to the machinery of the ship. The electrical and engineering staff number about 120; the remainder are stewards and their assistants.

Being rather deep in the water it was thought desirable, in order to get safely over the bar of the Medway, that the "Great Eastern" should avail herself of the high tide of Saturday, the 24th, for that purpose, and accordingly on that day she was removed to the Nore, where she completed her coaling and adjusted her compasses, which was effected by Captain Evans, the Government officer, who undertakes that duty for the Royal Navy. Mr. Canning and Mr. Clifford at the same time completed the overhauling and running experimentally of the paying-out and other cable machinery, and, in conjunction with the Captain and a Government officer lent for the purpose, arranged the code of marine signals for communicating with the other ships. These are Bolton's system, and will be worked by sailors of the Royal Navy, lent for the purpose by the Admiralty.

The paying-out machinery is a very simple and easily-managed apparatus. In general principle it is much the same as has been previously and successfully used by Messrs. Canning and Clifford on the occasion of their submerging other cables, but it is greatly improved; and as to perfectness of fitting and manufacture is like clockwork. It has also added to it an apparatus for recovering the cable inwards, should it unfortunately be found necessary to cut it. As regards the machinery itself, a platform runs along the port side of the ship from the forehold to the mizenmast. A series of curved drop-plates run along this platform and form a trough, in which, at intervals, are small travelling wheels, to bear the cable along till it reaches the mizenmast. It then passes on to large V sheaves, in series, by which it is led to a still larger drum, around which it takes four turns, and whence it is led under the wheel of an ordinary dynamometer, and passes thence over three more wheels until it reaches the last V sheave, which is held about 9 ft. away from the ship's stern by projecting iron beams in which the sheave is geared. Over this sheave the cable falls into the sea. The brake power exerted upon the sheaves to check the too rapid egress of the cable, is very simple, being a modification of what is called Appold's brake, and is so arranged that at the slightest warning the entire pressure, or a part only, can be instantly taken off, and the cable be allowed to run free, or partially so, as may be required.

The "Great Eastern" started on her interesting expedition on Saturday, the 15th inst., bound in the first instance for Valentia. She left the Nore at twelve o'clock at noon, passed the Isle of Wight at two p.m. on Sunday last, passed Falmouth on Monday, the 17th, at ten a.m.; Cape Clear at eight p.m. on Tuesday, the 18th, and arrived at Valentia on Wednesday, the 19th, at six a.m.

The "Caroline," a small steamer containing the thirty miles of heavy shore end, manufactured by Henley, of which twenty-four miles will be laid from Ireland, and six from Newfoundland, started from the Thames early in last week, but having been detained by bad weather did not reach Valentia till nine a.m. on the 19th, being three hours after the "Great Eastern."

The weather is at present (Wednesday) very bad at Valentia; but if it moderates, the shore end will be laid on Friday or Saturday of the present week, and meanwhile the "Great Eastern" has put into Bantry Bay, where she can ride in perfect safety until she is required to come out and join her cable to

the tapered extremity of the shore end, which will be laid by the "Caroline."

The termini of the cable on the present occasion have been changed both in Ireland and in Newfoundland. In the latter the former terminus was at the further extremity of Trinity Bay in a land-locked arm of the bay called "Bull-arm." On the present occasion, a suitable spot has been found in the harbour of "Heart's Content," some forty-five miles nearer to the mouth of Trinity Bay, and one of the cleanest and most prosperous of the little communities which dot the coast of Newfoundland, and whose members live by the adjacent fisheries. It contains about six hundred inhabitants, and a harbour in which the "Great Eastern" can swing if necessary. At one end of the harbour is a sort of inner harbour, offering peculiar convenience for bringing the end ashore, while out in Trinity Bay the cable reaches two hundred fathoms water within six miles of its terminus in a channel which continues deepening to the mouth of the bay, and is thus effectually protected against grounding ice.

On the Irish side, instead of, as before, bringing the cable in round Valentia Island by way of Doulus Head and so to the mainland at Ballycarberry Strand, it will be landed wholly on the island at its south-western end, near Bray Head, at a spot called Foilhammon, in a creek protected from the westerly gales. These two changes have the effect, among other advantages, that they shorten the cable by some fifty miles, which will tend so far to increase the speed at which it can be worked. M. Varley and Professor Thomson take out with them a new instrument of their own design, the patent of which has been conditionally purchased by the Atlantic Telegraph Company, and which will, it is hoped, work through the cable at a speed of from seven to eight words per minute. H.M.S. "Terrible" and "Sphinx" are at Valentia, having been appointed by the Government to attend upon and assist the expedition.

STEEL MANUFACTURE.

THERE exists at the present time a strong and increasing tendency to substitute steel for iron in various branches of engineering manufacture. Steel girder railway bridges have already found their way into practical use in Holland, whilst in England steel rails are being extensively manufactured, not only for home, but for continental use. The manufacture of this latter article has also just been commenced in America, the first steel rail having been very recently rolled at Chicago from an ingot made by the Bessemer process. Ordinary rollers were used and the rail was rolled most effectually. Besides these purposes steel is being applied to many others of equal importance, and as the readier methods of its production become developed, so will its applications increase. It is already superseding wrought iron for many purposes as fast as a somewhat limited manufacture will permit, and its more general use in some respects only awaits an extended manufacture. During the last few years such important changes and improvements have been made in the production of steel as to constitute to some extent a revolution upon old customs. To Mr. Bessemer, perhaps, more than to any other man, are we indebted for the great changes which have been made in the process of manufacture. Added to what he has himself effected, are the results of the labours of others which he has been the indirect means of evoking. It cannot be denied that Mr. Bessemer has been a large contributor to our knowledge in dealing with iron in its crude state, so as to render it convertible into steel or refined iron direct from the pig. However much of incompleteness still attaches to the process of conversion, there yet remains the unquestionable fact that a vast amount of good work has already been accomplished. If the last ten years have greatly improved the production and

quality of iron and steel, they have not supplied the means of producing the same quality continuously from the same ore and fuel. It is only too true that, with the greatest care, a want of uniformity is sometimes found to occur in the character of the article produced. A quantity of plates may be made of supposed uniformity in strength and character, but it has happened that one plate has proved of inferior quality and has been the means of condemning the whole bulk. It is, therefore, essential that uniformity should especially characterise the productions of our manufacturers, to the end that they may be able to set up a high standard of excellence.

The Bessemer system of manufacture will undoubtedly establish a new era in the production of iron and steel. It may ultimately tend to convert nearly the whole process of manufactured iron into the superior metal. But, besides the Bessemer process which has become so deservedly popular, there are other methods of manufacturing steel well worthy of notice. A cast steel, very useful for some purposes, is produced from wrought iron by fusion with carbon in a crucible. The degree of hardness attained in the steel depends upon the quantity of charcoal used; for tool steel 1.5 to 1.7 per cent. is introduced; for soft steel less than 1 per cent. is sufficient. This produces a soft metal capable of receiving a high polish, and which casehardens without bending. Some of this steel, or partially carburised iron, has been carefully tested and found capable of sustaining a strain of thirty-five tons to the inch. Under the name of homogeneous iron, a Sheffield firm has also introduced a mild steel of this kind, which takes an average tensile strain of forty-one and a half tons, or double that of wrought iron. A peculiar process of manufacturing steel is adopted at the works of M. Bugeney, near Paris. These works are managed by M. Chenot and his son, from whom Mr. Fairbairn obtained the particulars of manufacture. M. Chenot employs a peculiarly constructed furnace, fifty feet high and about eighteen feet square at the widest part, in which he makes steel direct from the ore by converting it into what he calls sponge. To the main furnace are attached other furnaces containing the fires, the greatest care being taken that the gaseous products alone shall come in contact with the ores. The heated currents from the minor furnaces are distributed through the main furnace by means of numerous intersecting flues, which also serve to equalise the temperature at those parts where they come in contact with the ores. The time required for producing the sponge from the ore is five days. About a ton of this sponge is withdrawn from the furnace every twenty-four hours, by means of a movable grated platform, which is elevated by rack and pinions to the proper height in the furnace, where it receives the charge, and is lowered at the required temperature to the space prepared for its reception below. The air is carefully excluded by placing a luting of clay all round the platform over which the sponge is removed. Upon the process of calcination, or conversion of the ore into sponge, being completed, it is supplied with carbon by being soaked in oil or other grease. It is afterwards placed in wrought-iron retorts, and exposed to the heat of a furnace for two hours, in order that any excess of carbon it may have received shall be driven off. The next step is to reduce the sponge to a powder, which is afterwards compressed into bars in strong iron tubes by machinery. When it has reached this condition it is fit for melting, and is placed in a crucible with four tons of coke to one of steel. From the crucible it is run into ingots, and is finally prepared for the market by the hammer in the usual way. From this peculiar method of manufacture a superior description of steel is obtained.

In some works on the continent the German refining process is adopted, and steel is produced from crude iron by the decarburising effect of a blast in a furnace similar to a re-

finery. The pigs are melted by charcoal, and a strong blast is conducted over the molten surface of the iron. The mass of iron is stirred up so that every portion is brought under the action of the blast. The consolidation of the mass, and the colour of the flame, are the indications by which it is known that the process has been carried sufficiently far. The direct production of steel from cast iron in the puddling-furnace has for years been a fact well known to manufacturers, but only recently has puddled steel become an article of commercial importance. The process of converting cast iron into steel by puddling is similar to that employed for puddling iron, with, however, this difference: the iron is subjected to the oxidising action of the flame until the whole of the carbon is extracted, whilst in puddled steel the action is stopped before that point is reached. The iron is usually allowed to retain from half to one per cent. of carbon, and when this degree of carburisation has been arrived at, the puddler closes the damper and collects the steel into balls, which are hammered and rolled in the ordinary way. There is, however, one objection to puddled steel, and that is the want of uniformity to which it is liable. But mistakes in the manufacture may be corrected by breaking the bars, obtained as above, and rejecting the bad ones, the rest being piled, heated, and rolled into plates or bars. With care in selecting the iron, and in making, a tough malleable steel is produced, which has superseded wrought iron to a considerable extent in boiler making and shipbuilding. Its tenacity ranges from 35 to 40 tons per square inch, and its cost is about 25 per cent. in excess of that of wrought iron. Captain Uchatius produces cast steel direct from the crude iron by melting the pigs in a cupola, and running the products into a cistern of cold water. In the cistern is a dash-wheel which revolves very rapidly, and by striking the iron causes it to become granulated. The particles are afterwards intimately mixed with oxide of iron in a state of powder, or with sparry iron and fine clay. The quantity of oxidising material used is from 20 to 30 per cent. according to the amount of oxygen required. The ingredients are placed in a crucible, and fused in the steel melting furnace. The oxides cause the granules of cast iron to part with some of their carbon, and a slag is formed which purifies the steel. The quantity of steel obtained is somewhat in excess of the iron introduced in consequence of a portion of the oxides becoming reduced. The size of the granules affects the quality of the steel; if they are large the steel is hard, if small then the product is a soft steel, owing to the fact that decarburisation proceeds very slowly inwards from the surface. The tensile strength of this steel is about 90,000 lbs. per square inch.

Allied to the material under notice, is the gun metal produced by Mr. Mushet. It is made by cutting up bar iron into small pieces, each weighing about an ounce, and melting them in steel melting pots. A small proportion of two other metals is added, and from this the peculiar properties of the gun metal are derived. The introduction of charcoal regulates the hardness of the alloy, which, after fusion, is moulded in ingots. The proper treatment for this metal is to roll or draw it out at cast steel heat, as its tenacity becomes impaired by raising it to a welding temperature. Some samples of this gun metal, tested by Mr. Fairbairn, gave a breaking weight of 46-176 tons per square inch. This, however, does not equal some results obtained from the Bessemer steel by Colonel Wilmot, which gave upwards of sixty-eight tons per square inch. At the last meeting of the Academy of Sciences, a communication was received from M. Aristide Bérard upon a new direct method of producing cast steel by means of gases. M. Bérard operates on the melted metal alternately with reducing and oxidising agents. The necessary heat is produced by gases, the furnace used being of the reverberatory class, with two soles separated by a bridge, on

which coke is placed to remove the free oxygen. For fifteen minutes air is sent through the metal on one side, the other being treated with a mixture of hydrogen and carbonic oxide free from sulphur. The treatment is then reversed for another fifteen minutes. The process is thus explained. While oxidation goes on, part of the iron is oxidised to protoxide; the earthy metals, such as silicium, aluminium, calcium, &c., are also oxidised, and probably combine with the oxide of iron and form compound silicates. The sulphur, phosphorus, and arsenic also oxidise and pass away. During the process of reduction, the oxide of iron is reduced and the other metals remain in combination with the silica forming scoria, which floats on the surface. Any sulphur, phosphorus, or arsenic which escaped oxidation will then form a volatile hydrogen compound. The final process is that of decarburisation, which is effected by the air blast. It is stated that cast steel of very high quality is obtained by this method of treatment. M. Bérard observes that manganese plays an indefinite part, the certain effect of which is to facilitate the process of converting the iron into steel.

Much has been said and written upon the composition of steel, and various theories have been propounded as to its composition and the elements requisite for the production of the best varieties of steel. M. Frémy has made very extensive experiments, which have led him to form the opinion that iron in its three states—cast iron, steel, and wrought iron—is due not only to the different proportions of carbon they contain, but also to the presence of nitrogen. Mr. Mushet, again, has advanced a theory that titanium is essential in the manufacture of steel. Titanium has a great affinity for nitrogen and carbon; and if nitrogen is requisite, it is possible that titanium might act as a carrier of nitrogen and carbon. Upon the whole the investigations and experiments with respect to steel are as yet very limited; knowledge in this direction requires extending, and this is the more important as the use of steel increases. With this development of the manufacture will come a better practical knowledge of its requirements, and out of this only can we hope to establish perfection.

SCIENTIFIC AEROSTATION.

THE art of traversing the air by means of balloons is of comparatively recent date. The germ of the invention of the balloon is to be found in the discovery by Cavendish, in 1766, of the remarkable lightness of hydrogen gas. It first occurred to Professor Black, of Edinburgh, that a light envelope filled with this gas would rise of itself, and he procured a thin animal membrane to make an experiment, which, however, he never carried out. Cavallo, in 1772, made the first practical attempt at ballooning by inflating swine's bladders with the gas. But he failed; and it was left for the Brothers Montgolfier to perfect the idea and to invent the balloon. The first attempt to render the balloon of practical utility appears to have been made in 1794, during the wars of the revolution, when an aerostatic institution was formed at Mendon, near Paris, for training a corps of "aerostiers" in order to observe the enemy by means of balloons. At the battle of Fleurus, near Charleroi, fought against the Austrians, a balloon, under the management of the corps, was present, and, according to the testimony of Jourdan, the general in command, it rendered signal service. More recently, if report be correct, a similar method was adopted during the seven weeks' campaign in Italy, in 1859. Balloons have also been enlisted in behalf of science by a past generation as well as in recent times. On the 18th July, 1803, Robertson and Lhoest made the first ascent for avowedly scientific objects, at Hamburg. These observers testified to the diminution of terrestrial magnetism, and the general feebleness of electrical and galvanic phenomena

in the rarer portions of the atmosphere. These results were considered of such importance by the French Institute that they arranged for another ascent. The management of the balloon and of the physical experiments was entrusted to MM. Biot and Gay-Lussac, who started on the 20th August, 1804. This expedition proved unsuccessful, and a second was undertaken shortly afterwards by Gay-Lussac alone, when he rose to a height of 23,000 ft. After a series of experiments, the French savans were unable to confirm the results given by Robertson and Lhoest; they could not find any perceptible diminution in the intensity of electrical phenomena in the upper air. Since that time until the present, very few scientific aerial voyages have been undertaken, the principal being that of Humboldt in America, those made by Mr. Rush, accompanied by Mr. Green as steersman, on behalf of the British Association during 1847-9, and those by MM. Barral and Bixio at Paris in June and July, 1850. Although, from accidents, the two last-named ascents were of short duration, yet some interesting results accrued therefrom. Amongst other things, the aeronauts noticed that they passed through a cloud of icicles which appeared to them to sustain themselves in the air contrary to the laws of gravity. Upon their horizontal surfaces they saw beneath them an exact image of the sun, formed by the reflection of the luminous rays on the crystals of ice floating about in a foggy atmosphere; it was further observed that the temperature of the cloud was as low as minus 40 deg., a far greater degree of cold than has been experienced in later ascents. No facts of importance appear to have been established by any other ascents than the last noticed, and the contributions of balloons to positive science might be set down at almost nothing, until very recently, when the revelations made by Mr. James Glaisher have given a fresh impetus to and awakened a new interest in aeronautics.

More than two years since, Mr. Glaisher communicated to the Royal Institution the results of eight ascents he had made for the purpose of scientific research in the higher regions of the atmosphere. Since that time he has made seventeen additional aerial voyages and has added many interesting and important facts to the annals of physical science. In making a balloon ascent, a novel sensation is at first experienced; at great elevations the air is exceedingly cold and dry, and should the aerial traveller rise to an elevation too great for his power of endurance he enters upon a painless death, which is only comparable to that of a mountain traveller who, benumbed and insensible to suffering, yields to the overpowering lethargy. As in the latter so in the former case, the only means of safety lie in moral energy. The subjects of research by means of balloons may be classed under six heads:—First. To determine the rate of decrease of temperature with increase of elevation, and to ascertain whether the results obtained by observations on mountain sides—viz., a lowering of the temperature of 1 deg. for every increase in elevation of 300 ft.—are correct or not. Secondly. To determine the distribution of the water in the invisible shape of vapour in the air below the clouds, in the clouds themselves, and above them, at different elevations. Thirdly. To compare the results, as found by different instruments, together. 1. The temperature of the dew point, as found by dry and wet thermometers (free); dry and wet thermometers (aspirated), or air made to pass rapidly; Daniell's dew point; Regnault's dew point (blowing); Regnault's dew point (air made to pass rapidly). 2. To compare the readings of mercurial and aneroid barometers, &c. Fourthly. Solar radiation, by taking readings of the blackened bulb thermometer fully exposed to the sun, with simultaneous observations of the dry bulb thermometer, and also of observations of Herschel's actinometer. In the fifth place, to determine whether the solar spectrum, when viewed from the earth and far above it, exhibits any differ-

ence; whether there are a greater or less number of dark lines crossing it, particularly at the approach of sunset. Lastly, to determine whether the horizontal intensity of the earth's magnetism is less or greater with elevation. Upon most of these points a large amount of information is afforded by Mr. Glaisher's experiments, the results of which he has recently placed before the Royal Institution in a lengthy and exhaustive communication.

In determining the first point, as to decrease of temperature, it was found that the state of the sky exercised a great influence, which rendered two sets of experiments necessary, one set with cloudy, and the other with clear skies. The results of a series of experiments show the decline of the temperature of the air with elevation, when the sky was cloudy, to be 4.5 deg. at the height of 1,000 ft., or 1 deg. in 223 ft. From 1,000 to 2,000 ft. the decline was 3.6 deg., or 1 in 278 ft.; from 2,000 to 3,000 ft. 3.7 deg., or 1 in 271 ft.; from 3,000 to 4,000 ft. 3.4 deg., or 1 in 295 ft.; from 4,000 to 5,000 ft. 3.3 deg., or 1 in 333 ft. From 9,000 to 10,000 ft. the decline was 2.2 deg. or 1 deg. in 455 ft.; from 15,000 to 16,000 ft. 2.1 deg., or 1 in 477 ft.; and from 22,000 to 23,000 ft. 0.8 deg., or 1 in 1,250 ft. Up to 5,000 ft., the number of experiments upon which each result is based varies from 13 to 22. From 7,000 to 16,000 ft. the results are based upon four experiments, which were made on the 28th of June and the 29th of September, 1863, on which days the balloon was frequently enveloped in fog and clouds to the height of three and four miles. The results above 16,000 ft. were obtained on the former of the above days only during the ascent and descent, the sky being covered with cloud when the balloon was between 4 and 5 miles high. The decline of temperature with elevation, when the sky was clear, was found to be 6.2 deg. at 1,000 ft., or 1 deg. in 162 ft. From 1,000 to 2,000 ft. 4.7 deg., or 1 in 213 ft.; from 2,000 to 3,000 ft. 3.8 deg., or 1 in 264 ft.; from 3,000 to 4,000 ft. 3.3 deg., or 1 in 304 ft.; from 4,000 to 5,000 ft. 2.9 deg., or 1 in 345 ft.; from 9,000 to 10,000 ft. 2.4 deg., or 1 in 417 ft.; from 14,000 to 15,000 ft. 1.7 deg., or 1 in 588 ft.; from 19,000 to 20,000 ft. 1.3 deg., or 1 in 771 ft.; and from 28,000 to 29,000 ft. the decline was 0.8 deg., or 1 deg. in 1,250 ft. Up to the height of 22,000 ft. the number of experiments varies from 7 to 17, and there can be but little doubt that the numbers showing the decrease of temperature are very nearly true, and approximate closely to the general law. Above 24,000 ft. the number of experiments is comparatively few, but the results accord with those obtained from experiments at lower elevations. Under a clear sky a decline of 1 deg. in temperature takes place within 100 ft. of the earth, and at heights exceeding 25,000 ft. 1,000 ft. of vertical height have to be passed through for a decline of 1 deg. of temperature. By adding together successively the decline of temperature for each 1,000 ft. the whole decrease of temperature from the earth to the different elevations is found. The results with a cloudy sky are as follow:—From 0 to 1,000 ft. the decrease was 4.5 deg. or 1 deg. on the average of 223 ft.; from 0 to 2,000 ft. 8.1 deg., or 1 deg. on the average of 247 ft.; from 0 to 3,000 ft. 11.8 deg. or 1 deg. on 255 ft.; from 0 to 4,000 ft. 15.2 deg., or 1 on 263 ft.; from 0 to 5,000 ft. 18.5 deg., or 1 on 271 ft.; from 0 to 10,000 ft. 31.0 deg., or 1 on 321 ft.; from 0 to 15,000 ft. 42.1 deg., or 1 on 356 ft.; and from 0 to 23,000 ft. 51.7 deg., or 1 deg. on the average of 445 ft. These results, showing the whole decrease of temperature of the air from the earth up to 23,000 ft., differ very considerably from those with a clear sky. In the latter case the numbers showing the average increase of height for a decline of 1 deg. of temperature from the ground, are all smaller than those with a cloudy sky at the same elevation. The experiments show that a change takes place in the first 1,000 ft. of 1 deg. on an average in 162 ft., increasing to about 300 ft. at 10,000 ft. In 1862 this

space of 300 ft. was at 14,000 ft. high, and in 1863 at 12,000 ft.; therefore the change of temperature has been less in 1863 than in 1862, and less in 1864 than in 1863. The experiments have all been taken at different times in the year. Without exception the fall of 1 deg. has always taken place in the smallest space when near the earth.

The observations upon the second head, for determining the degrees of humidity of the air, when treated in a similar manner to the preceding, show the law of moisture to be, with a cloudy sky, a slight increase from the earth to the height of 3,000 ft. After this a slight decrease occurs to 6,000 ft., the degree of humidity being at this elevation nearly of the same value as on the ground. From 6,000 to 7,000 ft. there is a large decrease, and then an almost uniform decrease to 11,000 ft. It increases again from 12,000 to 16,000 ft. and then decreases. With a clear sky the law of moisture is shown to be a slight increase to 1,000 ft., a considerable increase between 1,000 and 2,000 ft., a nearly constant degree of humidity from 2,000 to 5,000 ft., and subsequently a gradual decrease to 12,000 ft. The numbers at greater heights become rather irregular. Whether the sky was cloudy or clear Mr. Glaisher invariably found that, at extreme elevations, the air became very dry, but, as far as his experiments went, never quite free from water. The results for temperature were laid down on a diagram at the end of 1863, and the resulting curve was a hyperbola. Continuing this curve upward and reading out the decrease of elevation, the result would be that at the height of 50,000 ft. the decline of temperature from the earth would be 83 deg. At 100,000 ft. or 19 miles, the decline would be 97 deg., at twice that distance 106 deg., at 100 miles 112½ deg., and at 200 miles 115½ deg. This shows that large changes occur near the earth, amounting to 24 deg. in the first mile, and becoming less and less the further removed, until the change from 100 to 200 miles is less than 3 deg. The foregoing results were deduced chiefly from experiments made in the summer and during the day. In order, therefore, to ascertain whether that law held good at all times of the year, experiments were made at other seasons. From these it was found that the season and the time of the day influenced the results very materially, the experiments made during the winter months differing very much from the general laws. The particulars of each ascent are such that they cannot all be combined or all used in deducing general laws. Recent ascents, made under similar conditions to those from which the laws of decrease of temperature were found, when combined, do not affect the previous results, but ascents made in winter differ very greatly, and this deviation is of great importance. Mr. Glaisher met a strong current of air from the S.W. nearly one mile in depth, which passed over this country on the 12th January, and continued for many days, and which must have exercised great influence. This is the first instance of a stream of air of higher temperature than on the earth having been met with. The observation of this south-west current is highly important, as bearing upon the very high mean temperatures experienced during winter, the probability being that the variations of our winters are due to its fluctuations. The general result of the differences in the law of decrease of temperature, lead to the conclusion that the theoretical law of refraction now used must be abandoned, and that every observatory will have to determine its own laws independently.

With regard to solar radiation, the blackened bulb thermometer and Herschel's actinometer observations, Mr. Glaisher found on the 31st of August last, that, at the heights of 7,000 and 8,000 ft. the blackened bulb thermometer, exposed to the full influence of the sun, read only 3 deg. higher than the shaded thermometer. On the 29th Septem-

ber, at the height of 14,000 ft. the excess of reading of the blackened bulb was $2\frac{1}{2}$ deg. only under a bright sun; the increase of readings of the actinometer was from 3 to 5 divisions only. At 13,000 ft. the excess of the blackened bulb readings increased to 4 and 5 deg., and the increase in one minute of the actinometer readings was 7 to 8 divisions. At the height of 3,000 and 4,000 ft. the influence of the sun increased, raising the blackened bulb to 7 and 8 deg. in excess of the shaded thermometer; the scale readings of the actinometer increased to 20 and 25 divisions in one minute, and on reaching the ground the increase in the same time was from 45 to 50 divisions. On some occasions the readings of the shaded and exposed thermometers have been found to correspond, whilst in others the blackened bulb thermometer has read lower than the shaded thermometer. Hence, it appears that the heat rays in their passage from the sun pass the small bulb of a thermometer, communicating little or no heat to it. Herschel's actinometer invariably gave similar results. The inference is, that the heat rays from the sun pass through space without loss, and become effective in proportion to the density of the atmosphere or the amount of water present through which they pass. Another point established by practical observations is, that the velocity of the air at the earth's surface is much less than at high elevations. On one occasion the balloon traversed a distance of 95 miles in 2 hours 47 seconds, the horizontal movement of the air on the earth in the locality traversed being registered as 33 miles during the above time. On another occasion a trip of 35 miles was accomplished by the balloon in the same time that the air travelled 8 miles on the earth. Still greater was the difference in another instance, when the distance traversed by the balloon was 70 miles, and the distance traversed by the air below was recorded as 6 miles only. From a series of experiments the conclusion is that at high elevations a considerable increase occurs in the velocity of the air, which increase, however, is not constant in relation to the velocity at the surface of the earth. Observations also determine the existence of widely differing currents in the atmosphere, the wind in some cases having been found to change from east to west in the course of a voyage. Respecting the comparison of the temperature of the dew point by different instruments, it is found that in all the experiments there is no certain difference in the determination of the dew point by Daniell's and Regnault's hygrometers. This temperature, determined by the use of the dry and wet bulb thermometers, appears to be very closely approximate to the results obtained by either of those instruments. The balloon, as we find it, certainly claims a position among the most important of human inventions, and will continue to do so if even it remains an isolated power. But this is not its probable fate; it has already done for science that which no other power has accomplished, and there are around us growing signs of its further utilization.

DIFFUSION OF GASES.

THE recent application by Mr. Ansell, of the Mint, of the principle involved in the action of gas diffusion, to the construction of life-saving apparatus for coalpits and mines, has imparted new interest to the subject, and converted a scientific curiosity into a valuable fact. It has long been noticed that the laws which governed the movements of mixed gases were of a totally different character to those which operated upon mixed liquids. In the case of the latter, for example, they are invariably found to arrange themselves in layers, as it were, and in exact accordance with their specific gravities, the lightest finding their way to the surface and the heaviest to the bottom of the vessel in which they might happen to be deposited.

From this fact the deductions were made that no chemical action exerted itself to effect their incorporation, and that by sheer force of gravitation each liquid assumed its relative position. With respect to gases, which also vary in density to a very considerable extent, no such separation takes place. If nitrogen, the specific gravity of which may be taken at 972 thousandths of that of the ordinary atmosphere, be mixed in equal quantities with carbonic acid gas, the density of which far exceeds the density of air, diffusion complete and perfect at once takes place, and all portions of this compound will be found to possess a mean specific gravity; this happens whether the heavier or the lighter gas be introduced below the other. Again, carbonic acid gas is twenty-two times heavier than hydrogen, yet it readily ascends through it, the hydrogen descending through the denser body till ultimately an exactly uniform compound is produced. Such, in brief, is the action of gas diffusion, and which is found to be invariable. Perhaps, no scientific inquirers have done more to establish a correct knowledge of the molecular mobility of gases than Professor Graham and his able coadjutor, Mr. Stoikowitsch. These two gentlemen have patiently and persistently experimented on the subject for a series of years, and their labours have been crowned largely with success. In their first examination into the paradoxical movement of gases of greatly varying densities, they employed an apparatus of a very simple nature, and which was termed a diffusometer. This was nothing more than a plain cylindrical glass tube ten inches in length and one inch in diameter. It was closed at one end by a porous plate of plaster of Paris a third of an inch in thickness. Biscuit ware or graphite was subsequently found to answer the latter purpose, that of closing the tube equally well, porosity being the desideratum.

In the application of the tube primarily it was filled with hydrogen gas over a mercurial trough, a sheet of gutta-percha for the moment covering the porous plate and rendering it impervious. On the removal of the gutta-percha, gaseous diffusion through the pores of the plate immediately took place, the open end of the tube being still inverted in the mercury, and in the space of forty minutes the tube contained only atmospheric air. During the process the mercury rose in the tube to a height of six or seven inches, thus showing the intensity of the force with which the impenetration of different gases is effected. The rapid passage of the gas through the minute pores of the plate is a remarkable phenomenon, and it seems to demonstrate the molecular theory completely. In a mass it would be impossible for the gas to penetrate the earthenware medium at all. Molecules, however, may be supposed to pass through it wholly unimpeded by friction, for the smallest pores that can be imagined to exist in the plate are as tunnels in comparison with the infinitesimal particles of a gaseous body.

According to the generally received hypothesis, a gas consists of solid and perfectly elastic atoms, which move in all directions and with different degrees of velocity in different gases. Confined in a vessel, the moving particles are constantly impinging against its sides and occasionally against each other. If the containing vessels be porous, then gas is projected through the open channels, and escapes. Simultaneously the external air is carried inwards in the same manner and takes the place of the escaped gas. To this atomic or molecular movement is due the elastic force and the power to resist compression possessed by gases. This movement is accelerated by heat and retarded by cold. Even when the same gas is present both within and without the vessel, or is in contact with both sides of the porous plate, the action goes on with equal speed. Enough has now been said to convey a clear idea of the remarkable effects of the diffusion of gases, and to lead to a more exact comprehension of Mr. Ansell's Fire Damp and Gas Detector, to which we referred

in a previous number of the *MECHANICS' MAGAZINE* (May 26th, 1865). Mr. Ansell is at present engaged in the introduction of his apparatus into several "fiery" mines, and there is little doubt that its sensitive action will make it an invaluable appliance for the discovery of mine gas or carburetted hydrogen, and for warning the miner of its presence. The principle upon which Mr. Ansell's various modifications of the detector are based is unquestionably that of Mr. Graham's "Diffusometer." The merit of its application to the purpose named is nevertheless entirely due to the first-named gentleman. The recent fearful catastrophe at Tredegar, and the verdict of manslaughter [which has followed it, give additional importance to the subject in question, and demand that Sir George Grey's attention should be given to the matter.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

Oxygen as a means of Economising the consumption of Coal-gas—Signalling at Sea by Means of the Magnesium Light—Proposed Method of Ventilating Railway Carriages—The Question of Ozone v. Nitric Acid.

A COMPANY is being formed in Paris to manufacture oxygen by the method of M. Archereau, which we described last week. The use to which the oxygen is to be applied is that of economising the consumption of coal-gas for lighting purposes. The company intend to lay down pipes side by side with the existing gas-mains, and from these mains to carry pipes into the houses or workshops of those consumers of ordinary gas who may be willing to avail themselves of the economy to be obtained by burning it in pure oxygen instead of in atmospheric air. The oxygen is to meet the carburetted hydrogen only as the latter issues from the orifice of the burner, so that there will be no danger of explosions. As a coal-gas flame supplied with pure oxygen gives out eight times as much light as a similar flame supported only by the diluted oxygen of the atmosphere, the customers of the new company are to burn only one cubic foot of ordinary gas for every eight cubic feet they burn now, and their saving, after paying for the oxygen which is to effect this great economy of consumption, is to amount to fifty or sixty per cent. of the amount of their present gas bills. Moreover, they are to obtain a very much whiter and more brilliant light than they get at present. Such is the promise; we shall see what comes of it.

Captain F. J. Bolton, the inventor of the "flashing" system of signalling, which he introduced about four years ago, and which the Board of Trade is about to incorporate with the commercial code of signals, has recently tried some experiments, at the instance of the Government, with a view to ascertain how far the magnesium light is adapted to be used in signalling by his method. Only the lime-light had been used for this purpose until the evening of last Tuesday week, when Captain Bolton, accompanied by Captain Colomb, R.N., experimented with the magnesium light on board the "Great Eastern," then lying off Shoeburyness, about six miles from the shore. They were enabled to hold a lively conversation with Shoeburyness, whence their signals were replied to by means of the lime light. The experiments proved the magnesium light to be quite as effective, for signalling on Captain Bolton's plan, as the lime light,—than which it is at once much cheaper and very much more convenient.

M. Seris, of Dax, has invented a system of ventilating railway carriages which is said to do away entirely with that plague of dust to which railway travellers have hitherto been condemned in dry weather. We are not acquainted with any particulars respecting his method, but we are informed that it is shortly to be tried, by the express order of the Emperor, on the line between Bordeaux and Marennes.

M. Auguste Larson, a young workman employed in the iron foundry of Messrs. Holmberg and Co., of Lund, in Denmark, has invented a method of casting iron tubes by pouring molten iron into a cylinder kept in a state of very rapid rotation. The rotation of the cylinder has the effect of forcing the liquid metal against the sides of the cylinder, and the result is a tube of perfectly even bore. Messrs. Holmberg and Co. have patented this invention both in Denmark and in France.

Many chemists have supposed that ozone cannot come into contact with nitrogen without instantly combining therewith to form nitric acid, and have therefore maintained that free ozone never exists in the atmosphere, and that when the papers which are used as a test for ozone are supposed to indicate the presence of that body in the air, what they really indicate is simply the presence of nitric acid. M. Hozeaux, whose discovery of the periodicity of the variations in the quantity of ozone in the atmosphere we recently recorded, has set this matter at rest by applying Boussingault's exceedingly delicate test for nitric acid to papers prepared with starch and iodine and rendered blue by the action of the atmosphere. If the coloration of these papers had been due to nitric acid, Boussingault's test would certainly have shown the presence of that compound; but not the least trace of nitric acid was detected in them, so that their coloration was unquestionably occasioned by free ozone.

NORTHERN INSTITUTE OF MINING ENGINEERS.

THE general annual meeting of the members of the North of England Institute of Mining Engineers commenced its sittings in Manchester, on the invitation of the South Lancashire and Cheshire Coal Association, in the Lecture Theatre of the Royal Institution, on the 11th instant. The chair was taken by Mr. J. T. Woodhouse, one of the council of the institute, in the absence, through illness, of Mr. Nicholas Wood. The first paper read was by Mr. Joseph Dickinson on "Some of the leading features of the Lancashire Coalfields." This was followed by a paper on "Direct-acting Pumping Engines and direct-acting Winding Engines," by Mr. J. Knowles. The next paper was on "An improved plan of Drawing Coals," by Mr. Robert Aytoun, after the reading of which Mr. Morley delivered an address on the subject of Safety Cages. At the conclusion of this address Sir E. Armitage's Cotton Mill at Pendleton was visited by the members, who afterwards inspected the Pendleton Colliery, one section proceeding to Clifton Hall Colliery. On Wednesday the arrangements for the day comprised visits to the North-Western Company's locomotive and engineering works, and the Bessemer Steel Works at Crewe, and the Kirkless Colliery and iron furnaces, and Lord Crawford's new canal pits at Wigan. The meeting at the Royal Institution was resumed on Thursday, when Mr. Maddison gave some particulars of the pumping engines in use at the Thornhill Collieries. Mr. Gilroy read a paper on "The Coal-washing Apparatus in use at the Ince Hall Collieries." This was followed by a paper on "Tail Ropes," by Mr. Greenwell; after which the members proceeded to Messrs. Platt's machine works at Oldham. The closing meeting was held on Friday morning, at which Mr. Embleton read a paper on "A Coal-cutting Machine," which was followed by one on "A New Water Gauge," by Mr. Daglish, the inventor. Upon the conclusion of this paper thanks were voted to the Council of the Royal Institution for the use of the rooms, to the local secretary, Mr. Peace, to the gentlemen who had contributed papers, and to the Chairman, with which the proceedings terminated.

ARTIFICIAL LEATHER.

MR. RICHARD BEARD, jun., of the Panonia Works, Clapham, and Mr. Walter Downing, of Lashmere, Battersea, have obtained letters patent for an invention for improvements in the manufacture of artificial leather, and in colouring, dyeing, or finishing the same, which latter improvements are also applicable to the colouring or dyeing of the ordinary leather cloth.

The following is the manner in which the process of manufacturing artificial leather is carried

out:—One or both sides of a fabric, by preference an open linen cloth, are first coated with a composition of oils and resins or gums as hereafter described, and a fleece or fleeces of cotton or other fibre are made to adhere thereto by means of pressing rollers. The most ready method is to spread, by the ordinary steam-heated spreading machines, the composition on one or both sides of the fabric and pass the same through steam-heated rolls, also passing through the rolls the fleece or fleeces of fibre on one or both of its sides. When it is desired that the surface of the fleece when on the fabric should be left clean and not be penetrated too much by the composition, the rollers must only be slightly warm and not much pressure applied by them to combine the material; when this is not of consequence, a more complete union and a better result will of course be obtained by pressing firmly and allowing the composition to penetrate. In this case it may be necessary to keep the rollers lubricated with ground talc (French chalk), or other convenient substance which will prevent the materials from adhering to them, and also the folds from sticking together as they are wound off, or from the pressing rollers. The fabric and fibre thus combined should then be hung in a warm temperature that it may completely dry; thereby the oil composition becomes perfectly oxidised. It will then be insoluble by the oil compositions usually employed in the manufacture of leather cloth, which can then be spread over the surface in successive coats, as is usual in the manufacture of leather cloth, whereby the side so dressed may be made to assume the appearance of dull or japanned leather, as may be desired. In some cases, in order to obtain increased thickness of fibre, the surface is spread again with the same adhesive composition as at first adopted, and another fleece is attached as before.

Ground leather, or other similar dust, is sometimes applied on one side of the fabric, either with or without the fibre, so as to give the appearance of leather on the back side of the manufactured material. This may be done by throwing in the ground leather or other dust, either in addition to the fibre or in place thereof, as the fabric is passing into the rolls, so that the whole may be well pressed together; or the leather or other dust may be applied separately, as directed for additional thickness of fleece. As little composition should be used in uniting the fabric and fibre as will firmly bind all together, so that the manufactured material may remain as soft as possible, but when desirable the combined material may at any stage of the dressing or coating with the ordinary compositions used in making leather cloth be dressed with the oils or grease employed in currying leather, which will, as with leather, give softness and flexibility; a small quantity will of course suffice. When the artificial leather is to be japanned, then this application of non-drying oil or grease must precede the japanning. The composition for uniting the fabric and fleece is by preference made by a mixture of boiled oil or boiled oil and oil scrapings and resins or gums so prepared that, when dried or solidified by absorption of oxygen, the combined fabric and fibre and composition shall not become hard or brittle, but whilst the adhesiveness and cohesiveness requisite are obtained, the flexibility of dried oil is maintained. The proportions of oil and resinous matter may vary according to purposes and quality of material required to be made therewith, and the kinds of oil and of resinous matter may vary in themselves and in proportion one to the other, according as their relative qualities and characteristic natures or properties vary, that is to say, that if very hard resins are used, then a greater proportion of non-drying oil may be desirable, also if a larger proportion of dried oil scrapings is boiled with the oil, then less resinous matter may suffice; the following has, however, been found a good combination:—56 lbs. linseed oil; 56 lbs. dried scraping of linseed oil, both boiled to as thick a consistency as possible; 7 lbs. common rosin; 21 lbs. Burgundy pitch; 7 lbs. commonest india-rubber (if in a resinous state from decomposition it will still avail). The whole having been melted together, add about 5 lbs. cod oil or other non-drying oil, grind the whole in convenient steam-heated mixing rolls, with from 30 to 35 lbs. white lead (dry) or burnt umber or other driers. This must be spread warm, and if of too thick a consistency may be thinned with some volatile spirit, such as mineral naphtha.

In some cases in place of applying the oil compositions used in the manufacture of leather cloth to the fabric coated with fibre, the surface coating of the fibre that has been applied to the fabric is dyed, and for this purpose (by preference) the aniline dyes are employed. The surface of the material may then be varnished with a suitable varnish. In such cases the surface of fibre must be kept clean; at the same time it must be pressed as flat as possible. This surface is then coated with a small quantity of size or albumen, and dyed by floating over it the desired dye, the process being repeated as may be requisite to get a good surface colour, the fabric being pressed between rollers between each coat. The surface may then be varnished with any suitable elastic varnish.

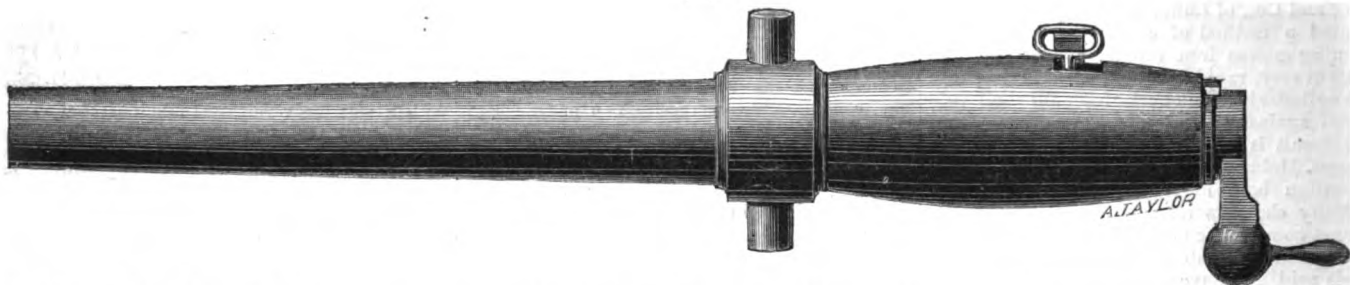
In order to colour leather cloth manufactured as hereinbefore described, or leather cloth otherwise manufactured, the dyes employed are obtained from aniline and its homologues; this is effected by dissolving the crystals of the aniline dyes in fusil oil that has been rendered anhydrous. To render fusil oil anhydrous gum arabic is mixed with it, by which the water will be absorbed, the gum arabic will settle to the bottom of the vessel containing the oil, and the oil may then be drawn off; other means may, however, be employed for rendering the oil anhydrous. The inventors prefer to dissolve in a gallon of the oil half an ounce of rosin or other crystals, but this will vary according to the shade of colour desired. When the colour has been dissolved in the oil, two fluid ounces of sulphuret of carbon and one ounce of ether are added to it. In order to colour leather cloth with this mixture, the surface of the leather cloth is floated or painted over with it, and the oily compositions of which the surface of the leather cloth is composed should have pigments mixed with them of somewhat the same colour as the colour with which it is to be subsequently coated. This process may be repeated to get deeper and richer effects of colour, and spirit varnish may or may not be mixed in small proportions therewith, for all or only the last coat of dye. The coatings of dye dry at ordinary temperatures. In order to produce a bronzed effect on leather cloth by the use of aniline dyes, the surface is covered with the aniline dyes dissolved in spirit. For this purpose four ounces of rosin or other crystals are dissolved in one gallon of pyroxilic spirit; four ounces of acetic or sulphuric ether are added thereto. After coating the surface of the leather cloth with this solution it is subsequently coated with any suitable varnish. The advantages gained by the above improvements are, firstly, an artificial leather is obtained, more closely resembling leather by reason of not showing the threads of the fabric on which it is made as is the case with ordinary leather cloth. Next, from the fabric and fibre being united with a composition, the artificial leather can be cut with a raw edge without tendency to ravel out as in an ordinary woven fabric. A much less expensive fabric can also be employed than in ordinary leather cloth, and at the same time the artificial leather or leather cloth possesses increased strength. By the dyeing process increased richness of colour is attained at a less expense than heretofore, and a nearer approach to the appearance of leather is gained, together with greater durability than is obtained by the painted and varnished surface of ordinary leather cloth.

LINDNER'S BREECH-LOADING CANNON.

THE principle of muzzle-loading undoubtedly possesses great advantages, inasmuch as the weapon in which it is adopted is endowed with a maximum strength and simplicity. But in strictness it is not a *natural* method of placing a charge at the bottom of the bore; indeed, it is exactly the reverse, as in loading at the muzzle we commence at the wrong end. It is furthest from the vent, or rather from the seat of the charge, and at the same time the most dangerous. But from the advantages it otherwise offers, it is clear that early artillerymen were wise in adopting it, and that we should not be justified in departing from it, unless we could gain more in rapidity of fire, convenience of loading, accuracy, and range, than we should necessarily lose in endurance and simplicity of manufacture. However, there can be no doubt now that, in all countries where labour has secured the assistance of modern machinery, the old principle of muzzle-loading has fallen into

LINDNER'S BREECH-LOADING CANNON.

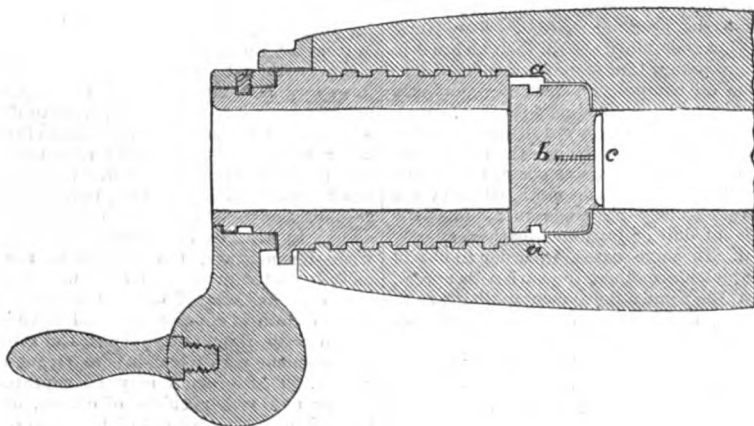
Fig. 1.



disfavour. England was the first power to introduce breech-loading artillery; and although the Armstrong gun possesses many remarkably good qualities, it is unquestionably open to several well-founded objections. We will only now refer to the breech arrangements, and there

to make it capable of acting as a good obturator. The accompanying illustrations represent a system in which these two objects appear to have been successfully attained. In the engraving, fig. 1 is an outside view of a breech-loading cannon which has been invented by Mr.

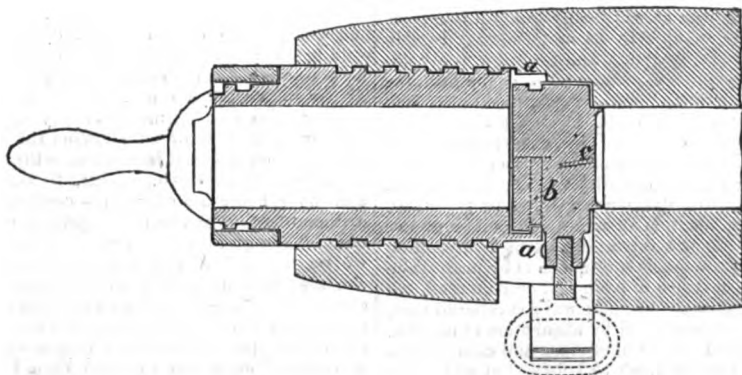
Fig. 2.



we find two very serious drawbacks. Firstly, the vent-piece has to be lifted up, drawn out, and sometimes even detached from the gun; this involves an early limitation of power, and opens the way to contingencies of a dangerous nature. Secondly, the vent-piece does not shut

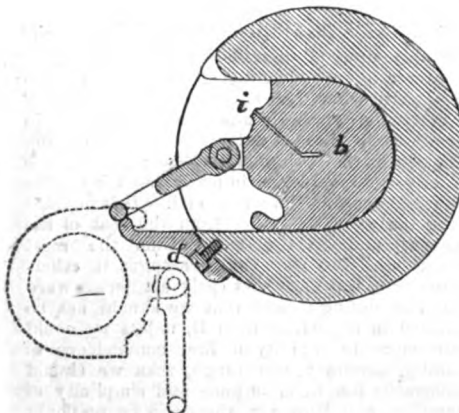
Edward Lindner, and the patent for which is being worked by Mr. Louis Sterne, of 25, Old Broadstreet, London. Fig. 2 is a longitudinal section, taken vertically through the breech, and fig. 3 a section taken horizontally through the same part; both showing the arrangement of the screw and

Fig. 3.



off the gases from the mechanism, whence fouling promptly takes place. It would, therefore, be very desirable, supposing the Armstrong

Fig. 4.



principle of a concentric hollow screw combined with a movable breech-piece to be correct, to avoid detaching the latter, and at the same time

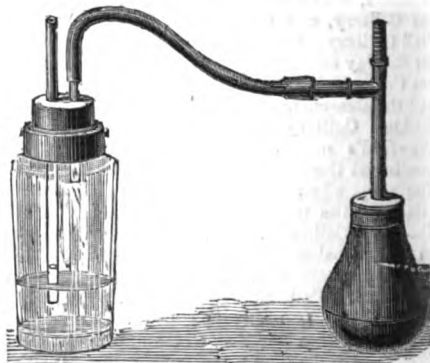
the breech. Fig. 4 shows the manner in which the breech-piece is withdrawn laterally from its position after firing. It will be observed that the hollow screw terminates at the fore-end with a kind of clasp ring *a*, figs. 2 and 3, half of which is out away. The breech-piece *b* is grooved at the rear, and so as to agree with the half-ring of the screw. It follows that as the screw recedes or advances, the breech-piece will necessarily either recede from or advance towards the bore. To turn this movement to account for shutting off the gases, the front face of the breech-piece is cup-shaped, as shown in the vertical and horizontal section of the breech in *c*. The cup is forced into the bore on the screw driving the breech-piece home, and is, *vice versa* withdrawn, on the screw receding with the said breech-piece. A horizontal aperture, fig. 4, is made in the walls of the gun to admit the vent-piece *b*; so that by seizing the handle of the latter, and drawing it on to the support *d*, the bore can be opened, and the tube inserted at *i*. From the foregoing description will be seen the advantages the Armstrong system would derive from this arrangement. By this simple improvement, the vent-piece is grasped by the screw, which prevents the occurrence of any of the evils attending the Armstrong gun.

MINIMETRIC ANALYSIS.

By DR. ANGUS SMITH.

At a meeting of the Literary and Philosophical Society Dr. Angus Smith explained a mode of analysis which he has called minimetric. The idea, he said, may perhaps not be quite new, but it is well to give the method a name. It is based mainly on the fact that we can retain in the memory with great exactness the character of a precipitate of a given degree of translucency. For carbonic acid the author finds a precipitate of carbonate of baryta caused in baryta by 2515 cub. c. of carbonic acid, or nearly three times that amount in lime water. If the carbonic acid in air is sought, the air is made to act on the baryta until the precipitate is obtained. In other words we use the smallest measure of air which will produce the precipitate. For this reason the name "minimetric" is adopted. The plan may be used for hydrochloric acid, sulphuric acid and sulphurous acid, sulphuretted hydrogen, &c., and probably has been used frequently without bringing it forward as a method for accurate use. Two ways of using this mode of analysis were described. The first was by use of a finger pump, an elastic ball with two valves. When pressed the air was driven out, and when expanding the air was drawn through the liquid. The air and liquid were then shaken together. This was repeated until the precipitate was attained. One easy method of finding the precipitate for comparison was by shaking half an ounce avoirdupois (14.17 cub. c.) with 23 oz. of air in Manchester, or nearly 30 oz. in London, or elsewhere, according to residence. Experiments made with this apparatus show it to be extremely delicate. The carbonic acid in the air of a room can be estimated in a few minutes.

A table is made of the following kind, but it must be adapted to the size of the bulb. The accompanying cut shows the bottle and finger pump.



For very bad air smaller bulbs were shown, such as were recommended for workshops, mines, &c.; a convenient size for common life is here given:—

No. of Strokes of the Finger Pump, or No. of Ballfuls of Air.	Per cent. of Carbonic Acid indicated in the Air.	Actual Amount of Carbonic Acid in the Air of the Ball.
		Grammes.
1	6.0	0.2515
2	3.0	0.1257
3	2.0	0.0838
4	1.5	0.0629
5	1.2	0.0503
6	1.0	0.0419
7	0.8	0.0359
8	0.75	0.0316
9	0.68	0.0279
10	0.566	0.0251
11	0.564	0.0229
12	0.0499	0.0209
13	0.0460	0.0193
14	0.0428	0.0180
15	0.0399	0.0167

In all cases only half an ounce of baryta solution was used.

Minimetric House and Workshop Method.—This method is partly described in the report on the air of mines, and long tables given. There were shown two modes of using it—first, with baryta water; second, with lime water. Suppose we desire to know if the air contains more than 0.04 per cent. of carbonic acid, we fill a bottle containing 5.422 oz. with air by pumping as elsewhere described, with a little finger pump, and shake it in half an ounce of baryta water. If there is any precipitate at all, the amount of carbonic acid in the air is above 0.04 per cent. This would indicate that the air is less pure than outside. If we allow 0.06 per cent. of carbonic acid in a room, we take a bottle of the size of $3.6 + 0.5 \text{ oz.} = 4.1 \text{ oz.}$, or 116.23 c.c. , and if, after a trial as before we find a precipitate, however small, or a decided, although slight milkiness, the air is deteriorated beyond 0.06. This relates to dwelling-houses. If for workshops $\frac{1}{2}$ p.c. (0.25) is allowed, a bottle of $0.867 + 0.5 \text{ oz.} = 1.367 \text{ oz.}$ or 38.744 c.c. is sufficient. This could go into the waistcoat pocket. If 0.5 or $\frac{1}{2}$ per cent. is permitted, a bottle of $0.433 + 0.5 \text{ oz.}$ is enough $= 0.933 \text{ oz.}$ or 26.475 c.c. This amounts to nothing more than shaking an ounce bottle. The addition of half an ounce is for the baryta water.

The lime water method will probably be adopted more usually, as lime is so common. The experiment is exactly the same as with baryta water, but larger bottles are required.

0.06 carbonic acid in the air gives no precipitate or milkiness when $\frac{1}{2}$ oz. of lime water is added to a bottle of the air containing.....10.9 oz.
(= 309 cub. cent.)

0.25 ditto ditto 2.997 oz.
(= 84.958 cub. c.)

0.5 ditto ditto 1.748 oz.
(= 49.564 cub. c.)

The author said that by this simple method the greatest refinement could be attained.

NON-EXPLOSIVE GUNPOWDER.

We recently noticed the discovery, by Mr. Gale, an electrician, of Plymouth, of a method whereby gunpowder may be rendered explosive or non-explosive at will. Some interesting experiments, illustrative of this discovery, were made last Saturday in a large tent at the Wimbledon rifle gathering. The process, which is very simple, consists of mixing two parts of dark impalpable powder with the gunpowder to be rendered non-explosive, thoroughly incorporating the two, and the operation is complete. The mixture at first sight differs little in appearance from the impalpable powder itself, except that on close inspection the shape of some of the grains of gunpowder can be detected. Each grain of gunpowder is isolated by an envelope of the impalpable or non-explosive powder, and as a consequence, when fire is applied to the mixture, the gunpowder will only explode grain by grain as the fire reaches it. A quick match was thrust to the bottom of a bowl of the mixture and set on fire. After the match had burnt beneath the surface a few grains of powder were exploded one by one until the match was consumed. To render the powder again explosive all that is necessary is to place the mixture in a fine sieve and sift away the non-explosive powder. The separation apparently can be perfectly effected. No particles of the non-explosive powder adhere to the gunpowder, which burns after the operation as rapidly and with as little residuum as before. The inventor states that in five minutes a barrel of gunpowder can be rendered non-explosive, and in another five minutes be restored to its original combustible condition. A shell might burst in a store of this mixture in bulk without any explosion except that of the shell itself. Gunpowder so treated may be stowed with perfect safety in any common shed or warehouse, and stowed also in bulk. Another reason why great care requires to be exercised in storing gunpowder is, that it absorbs moisture from the air very readily, and if not kept thoroughly dry soon becomes unfit for use. The non-explosive powder is stated by Mr. Gale to be in this respect totally different from gunpowder; that is to say, it does not absorb moisture from the atmosphere, and, as a consequence, it protects the gunpowder with which it is mixed. The inventor burnt some gunpowder which he stated had been kept for months in the mixed form under an open shed.

In spite of this exposure, the grains of gunpowder were as hard, and the combustion as rapid and complete, as if they had just come from the corning mill. It is true that the bulk and weight of the mixture are three times as great as that of the gunpowder itself, but it can be stored in bulk in very little if any greater space than is required by gunpowder in barrels; and, as regards the question of carriage, there is no doubt that, for commercial purposes, three tons of the non-explosive compound would not cost so much as one ton of gunpowder. Mr. Gale has been ordered by the Secretary of State for War to attend immediately before the Ordnance Select Committee, and submit his discovery to their investigation.

THE LEEDS ASSOCIATION OF FOREMEN.

A SOCIETY of managers, foremen, and draftsmen connected with the engineering trades of Leeds and district has lately been formed. The association is established for the purpose of bringing together those engaged in the direction and superintendence of engineering works; for mutual acquaintance, and promoting more frequent exchange of opinions on interesting questions constantly arising from the progressive nature of the mechanical trades; and for the formation of a library of standard mechanical and scientific works. Also, for bringing under the notice of members any subject or invention which, from its novelty, usefulness, or otherwise, may be instructive or interesting. Further, to grant pecuniary assistance to such members as may require it. This association proposes not to discuss on any occasion the politics of the trade. It has no secrets, but courts rather complete publicity. Its objects are solely philanthropic and instructive, tending to assist its members in creditably filling the important posts confided to them. The inaugural meeting was held on the 29th of June last, when the address was delivered by the president, Mr. Thos. Harrison, of the Steam Plough Works, in which he called attention to the objects for which the society had been formed, congratulated the members upon the number of names already upon the books, and particularly requested their attention to the real value that might result from such an association. It was also specially noted that the society was totally distinct from any trades' union. By following in its integrity the course mapped out by its founders, this association will ultimately prove of great benefit, not only to its immediate supporters but also to collateral branches of engineering industry.

THE ERICSSON GUN.

ANOTHER wrought-iron gun has been brought forward for trial in America. It is the invention of Mr. John Ericsson. This gun is of novel construction and valuable results are expected from it by its inventor. It is of 13-inch bore, and is composed of a barrel or cone of wrought iron, forged in the usual manner. This barrel is thick enough to give the necessary strength in the direction of the axis. To resist rupture in the opposite direction, it is surrounded by broad plate iron rings of the finest wrought iron, put on in a peculiar manner by hydrostatic pressure. These rings are of course without welds, and their fibrous character is preserved as they exist in the gun. According to the *New York Army and Navy Gazette*, this gun has undergone two official trials, during which the charges were gradually increased to 75 lbs. of fine powder, and the elevation to 35 deg. The result was a range exceeding $5\frac{1}{2}$ miles at this elevation, with a solid spherical shot. Owing to the severe strain put upon the trunnion band by the recoil at this great elevation, it fractured. Several fissures also showed themselves in the bore, a circumstance which is quite common where the bore is made of wrought iron. In the Horsfall 13-inch solid-forged gun, for instance, fissures larger than these showed themselves after half a dozen rounds; but the subsequent career of that piece, with greatly increased charges, proved that they did not practically affect its strength, which is the prime condition. But this difficulty might be surmounted by inserting a steel lining within the gun to protect the wrought iron from the action of the powder gases; but what is better still, is to construct the barrel or core wholly of steel. We should then have the ano-

maly of a built-up gun without a single weld in it. It is understood that a gun on this plan will shortly be commenced. We hope the most sanguine expectations of Mr. Ericsson may be realised in the construction of a gun strong enough to project a spherical steel shot, with 100 lbs. of powder. Mr. Ericsson is working in the right direction. Strength, endurance, calibre, are the essentials of the "coming" gun.

ON THE CONSTRUCTION AND WORKING OF THE CLYDE STEAM DREDGERS.*

By MR. ANDREW DUNCAN, OF GLASGOW.

THE improvements in the channel of the river Clyde were commenced in 1770, under the direction of Mr. Goulbourne of Chester. At that time the navigable depth to Glasgow was only 3 ft. at high water spring tides, with $1\frac{1}{2}$ ft. at low water; while the high water of neap tides did not reach Glasgow at all. The river was crossed by seven fords, one being as far down the river as Dumbuck, about twelve miles below Glasgow, which had only 2 ft. depth over it at low water. The first operation seems to have been the removal of the Dumbuck ford; and numerous cross jetties were afterwards shot out from either bank as far up as Glasgow, for the purpose of narrowing the channel, their outer ends being subsequently connected by parallel dykes. Soon after 1798, a few ploughs and a dredging machine worked by manual labour were employed in deepening the shallowest places; and the result of these operations was to enable vessels drawing 6 ft. of water to come up to Glasgow at high water spring tides.

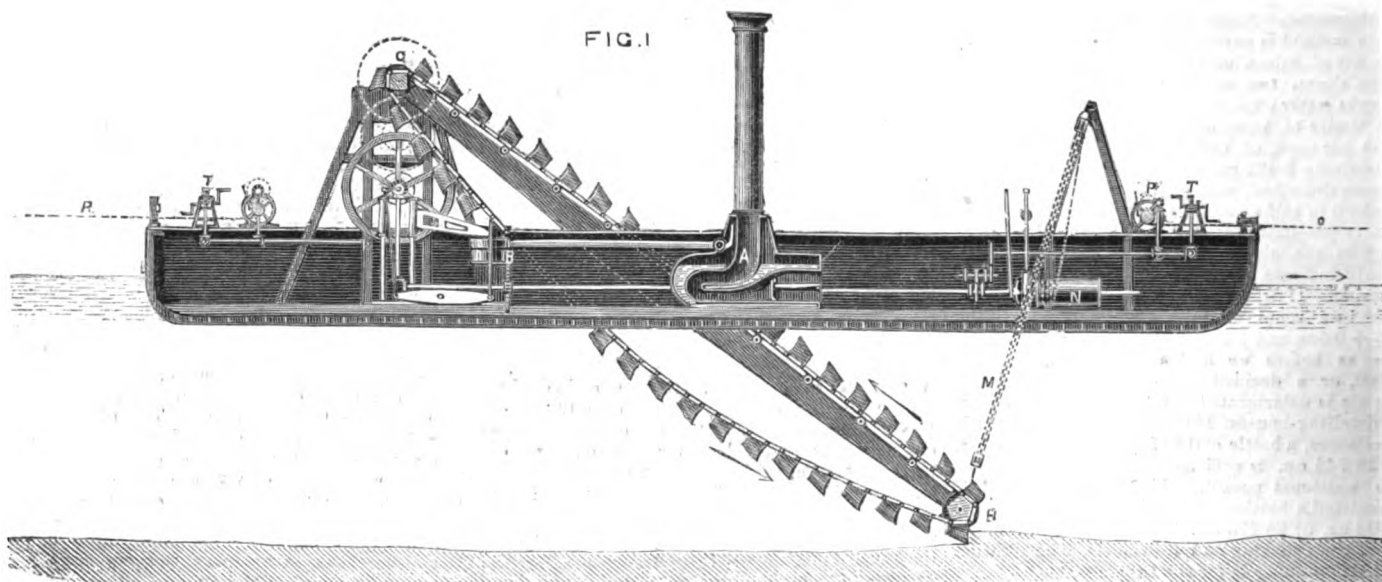
By the introduction of steam dredgers upon the Clyde, very important improvements have been effected in enlarging the channel of the river. In 1824 the first steam dredging machine was obtained, which now belongs to the town of Dumbarton, and is at work on the river Leven, running out from the foot of Loch Lomond into the Clyde. By that time the Liverpool traders were coming up to Glasgow at high water spring tides, drawing 11 ft. of water. In 1831, there were two vessels drawing 13 ft.; in 1836, six vessels drawing 15 ft.; in 1839, one drawing 17 ft.; in 1853, two drawing 19 ft.; in 1860, eight drawing 19 ft.; and in 1863, two vessels drawing 21 ft. arrived at Glasgow. The register tonnage of the vessels arriving and departing from Glasgow now exceeds three millions annually; and the minimum depth of the river is now not less than 12 ft. at low water, with a rise of 9 ft. at average spring tides and 7 ft. at neap tides. The deepening and widening of the channel is still in progress, and more powerful machinery is in course of construction in order to hasten on the work. The depth which is now contemplated throughout the whole length of the river up to Glasgow is 15 ft. at low water, giving 24 ft. depth of high water at spring tides and 22 ft. at neap tides.

As regards the deposit to be removed from the river bed, the greater portion of it comes from the drainage of the city, all the sewers of which discharge into the harbour, where the deposit lodges; also a considerable quantity of sand is brought down from the upper reaches of the river by the land floods, and lodges chiefly above Glasgow bridge. One of the two large double dredging machines is kept constantly at work in the harbour, the maintenance of which costs about £21,000 annually, and three-fourths of this amount may be said to be due to city sewage. The entire dredging plant of the river consists of two large double dredgers, and three single dredgers, making five in all; connected with which there are 350 punts, each capable of carrying 8 cubic yards or 10 tons of material; one tug steamer of 80-horse power; and four screw hopper barges; each capable of carrying 300 tons. During the last twenty years, 8,114,872 cubic yards or 10,143,590 tons of material have been removed by dredging; last year's work ending June, 1864, being 632,272 cubic yards or 790,340 tons.

The following is a general description of the two large double dredgers, Nos. 1 and 6, the latter of which is shown in the engravings, fig. 1 being a longitudinal, and fig. 2 a transverse section. The first double dredger, No. 1, was constructed in 1851 by Messrs. Murdoch Aitken and Co., of Glasgow. The hull is of iron, 96 ft. long, 31 ft. broad, and 10 ft. deep, drawing 5 ft. of water. The engine is a direct-acting marine

* Read before the Institution of Mechanical Engineers.

CLYDE STEAM DREDGERS.



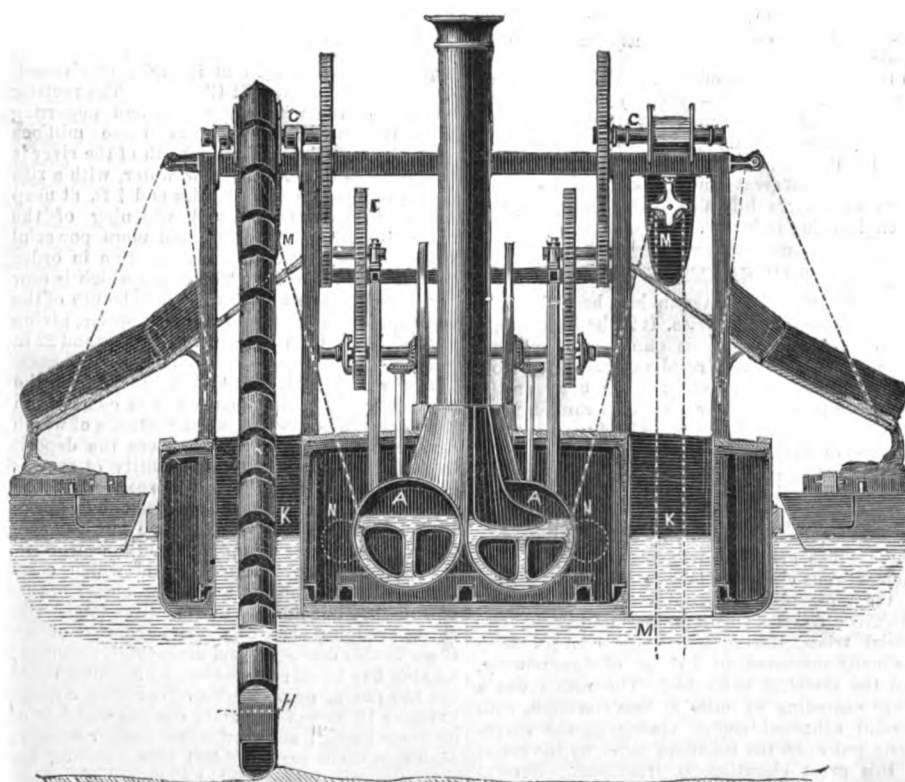
engine, with cylinder 27 in. diameter and 3 ft. stroke, and makes about 33 revolutions per minute. The boiler is a flue boiler with four furnaces, worked at a pressure of 4 lbs. above the atmosphere, and burning about 44 cwt. of coal per day of 10 hours. The bucket frames are of timber, trussed with iron rods, and the buckets can dredge in 22½ ft. depth of water. The buckets are 38 in number in each well, and each contains when quite full 3½ cubic feet. The motion is communicated from the engine to the upper tumbler by cast-iron shafting. The tumbler makes about 6½ turns per minute, or 13 buckets

ing over the stern; but this plan has the disadvantage of causing a loss of time while the punts are being shifted after each has been filled. Another disadvantage is that when working during flood tide in the lower reaches of the river, where the current is much stronger than in the harbour, the punts become nearly unmanageable, the current forcing them so hard against the stern of the dredger, which is always moored with its bow up stream, as to render the shifting of the punts when filled a work of considerable labour; so much so, in fact, that working on the flood tide in the lower reaches of the river was

in the engravings, was constructed in 1855 by Messrs. Thomas Wingate and Co., of Glasgow, and is arranged so as to discharge over the sides, in order to obviate the complaints brought against the previous dredger when working in the lower reaches of the river, for which this one was principally intended and is generally used. The crew required to work this dredger, exclusive of the crews on board the screw hopper barges, is twelve in all, namely,—captain, engineer, fireman, mate, cook, watchman, and six deckhands. Previous to the hopper barges being substituted for the small punts, this machine required a crew of twenty-one. The expenses of working during the year ending June, 1863, the hopper barges being used, amounted to,—Wages, £562 1s. 4d.; coals, £171 1s. 6d.; stores, £95 4s. 6d.; total working expenses, £828 7s. 4d. The annual average cost of repairs is about £980, being considerably more than in the case of No. 1 dredger; for as the latter is working in a soft soapy sludge, the buckets and links do not get out up so soon as if working in sand, as in the case of No. 6. The dredger is built entirely of iron, and is 120 ft. long and 33 ft. broad, with a flat bottom, and 5 ft. draw of water; the plates are 7-16ths in. thick at the bottom, and 5-16ths in. at the sides. The two boilers A A fixed in the centre of the vessel, are low pressure cylindrical flue boilers, 6 ft. diameter and 15 ft. long, working at 3 lbs. pressure above the atmosphere; and the coal consumed is about 2½ tons per day of ten hours. The engine B is a single side-lever condensing engine, with 37 in. cylinder and 3 ft. stroke, running at an average speed of about thirty-two revolutions per minute, and driving the tumbler shafts C C of the two bucket frames D D at the reduced speed of six revolutions per minute, by two sets of spur gearing, consisting of mortice wheels and cast-iron pinions. Either set of buckets can be stopped and started independently of the other by means of clutch boxes worked by levers upon deck.

The power is communicated to the tumbler shaft C C through friction wheels E E, which are adjusted so as to transmit only a definite amount of power, and to slip round freely whenever the resistance exceeds that limit, from the buckets cutting too deeply into the ground or meeting with any obstacle: by this means any risk of damage to the machinery is prevented. These friction wheels consist of one ring revolving within another, the inner one being keyed upon the shaft, and having a cylindrical recess of rectangular section turned in the circumference, 8½ in. wide and 1 in. deep, in which fit a series of cast-iron segment blocks. These are held in recesses in the outer ring and are each pressed against the inner ring by a set screw, adjusted to give the required amount of friction for driving the inner ring and the gearing connected with it. The bucket frames or dredging ladders D D consist each of a pair of wrought-iron plate girders, 77 ft. long and 3 ft. 9 in. deep in the centre fixed parallel to each other with 2 ft. 3 in. space between them, and stayed together by transverse plate stays. These frames carry a series of cast-

FIG. 2



per minute; but as the buckets are never quite full, the quantity lifted when working in good material is about 10 tons in 4 min., or about 2 cubic feet per bucket. Taking the year ending June, 1864, the total quantity of material lifted by this dredger was 143,360 cubic yards or 179,200 tons; and as the total number of engine hours was 2,483, the average quantity lifted per day of 10 hours was about 720 tons.

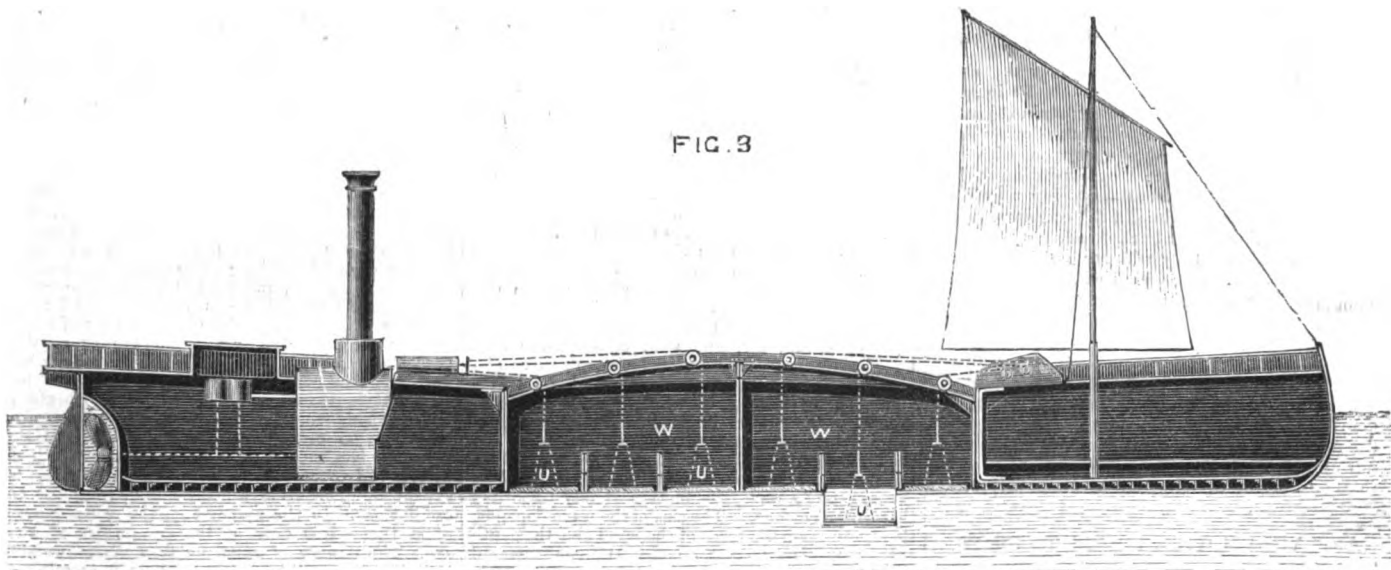
The material is discharged over the stern of this dredger, which arrangement was preferred to discharging at the sides, inasmuch as less room is occupied in filling the punts by discharg-

avoided as much as possible. The cost of this dredger was £3,500. The crew required to work the dredger and punts consists of eighteen in all, namely:—Captain, mate, engineer, fireman, bow oraneman, sternman, wellman, two deckhands, cook, watchman, and seven men connected with the punts. The expenses of working during the year ending 30th June, 1863, were:—Wages, £916 19s. 2d.; coals, £204 10s. 7d.; stores, £73 11s. 5d.; total working expenses, £1,195 1s. 2d.; and the average annual cost of repairs is about £580.

The other large double dredger, No. 6, shown

CLYDE STEAM DREDGERS.

FIG. 3



iron rollers, upon which the bucket links travel; and a cast-iron tumbler C and H, fig. 1, at the top and bottom ends, over which the links work. Each ladder is suspended at the upper end by cast-iron dead-eyes, firmly bolted to the main framing of the dredger; through these dead-eyes the upper tumbler shaft C passes freely, and round them the ladder turns in being lifted or lowered: thus the upper tumbler shaft C does not bear any part of the weight of the ladder D. The shaft C is of wrought iron, and works in top and bottom brass bushes in pillow blocks bolted to the main framing of the dredger. Each ladder works in a vertical well K, fig. 2, passing through the bottom of the vessel. There are 41 buckets to each ladder; they are constructed of 5-16ths of an inch wrought-iron plates, bent and riveted, with a flat back, $\frac{1}{2}$ in. thick, upon which four wrought-iron bars are riveted, having eyes at the ends. These are connected together by two intermediate links, 3 in. square, and jointed with 2 $\frac{1}{2}$ in. steelpins, the whole forming a continuous chain with 2 ft. pitch of the links. The pins are prevented from turning in the eyes of the bucket links which are not steelpins, and the eyes of the intermediate links are bushed with steel on the wearing side. In another dredger, No. 7, which is the most recent construction, the plan is adopted of inserting a bush of hard steel 5-8ths of an inch thick into the eyes of the single links, while they are hot; and when worn this bush is driven out and another inserted, so that the eyes of the links do not wear at all. The mouth of the bucket is made 1 $\frac{1}{2}$ in. thick at the point, tapered to $\frac{1}{2}$ in. at the sides, and is faced on the outside with steel $\frac{1}{2}$ in. thick welded on the plate, the mouth is shaped in a projecting scoop form, for excavating and lifting the material dredged, as each bucket in succession passes under the bottom tumbler H of the ladder, figs. 1 and 2.

The depth of excavation of the buckets is regulated by the lifting chain M, fig. 1, attached to the lower end of the bucket frame D, and hoisted at the rate of about 26 ft. per minute by the windlass or hoisting barrel N, which is driven by a small shaft from the engine through a clutch box and friction wheel, similar to those giving motion to the buckets and also worked by a lever upon deck. The depth of dredging is continually gauged during work by a man stationed at the bucket well K holding a gauging rod resting on the river bottom, and having the lifting lever at hand and also a brake handle for lowering the bucket frame, so as to keep the buckets constantly adjusted to a uniform depth of cut, according to the surface of the ground. A self-indicating gauge has also been fitted up on deck, so that the captain by glancing at the position of the bucket frame may in an instant tell at what depth below the surface of the water the points of the buckets are working. The greatest depth the dredger can work at is about 28 ft.

The forward motion for the cutting of the buckets is given by the bow chain O, which is 1 in. diameter, attached to a single-fluked anchor weighing 13 cwt. placed about 600 ft. ahead of the dredger when at the commencement of a cut. The chain is hauled in with a slow motion by the windlass P, driven by a second small shaft from

the engine through a clutch box and friction wheel, and having a set of change wheels for the purpose of regulating the rate of advance according to the nature of the material that is being excavated. This rate of advance varies from about 4 $\frac{1}{2}$ ft. per minute in soft sand to 1 $\frac{1}{2}$ ft. per minute in hard material. The dredging is done in parallel cuts of about 120 ft. length. A corresponding windlass with two mooring chains R at the stern of the vessel gives the means of drawing back the dredger to commence a second line of excavation parallel to the former one; this windlass is driven by a small high-pressure donkey engine with a pair of 12 in. cylinders, the dredging engine and machinery standing still during the time occupied in going astern, which is about 15 minutes, the speed being about 8 ft. per minute. Two side warp lines extending from each side of the dredger, serve to steady it constantly during the progress of each cut, and to shift its position into the new line of excavation; they are worked by the surging heads T T, driven by the engine, or by hand power when required. The kedg anchors for these side warps are placed forwards of the dredger; the warps are also passed round leading blocks when required, since it is desirable they should be as nearly at right angles to the dredger as possible. The two warps on the side next the sailing channel of the river are lowered or slackened out when any vessel is passing, but are immediately tightened up again when the vessel has passed.

This dredger, No. 6, has now been at work for nine years, and has not required any repairs excepting for the wear and tear of the buckets, links, and rollers, and the usual repairs on the hull, &c. The upper tumbler, however, having been found too low to allow of the shoot being placed at a sufficient height and slope for loading the large screw hopper barges, was raised 2 $\frac{1}{2}$ ft. higher. The steelpins of the buckets last for the year's work of about nine months, when the buckets require to be thoroughly overhauled and put in repair. The pins and links of the bucket chains last generally about four months, and are replaced from time to time as required; a supply of duplicates being kept ready on board for the purpose. The rollers over which the buckets travel in ascending the dredging ladder are of cast iron, 1 in. thick in the barrel, with wrought-iron spindles, having 1 5-8ths in. journals laid with steel, which last about three months before being worn out; these run in small cast-iron steps with hard wood caps, fixed on the top flange of the ladder, which are readily renewed when worn out, the cast-iron bush lasting about two months, and the wood cap about nine months. Each bucket weighs 5 $\frac{1}{2}$ cwt., and the total weight of each set of buckets and links is about 7 $\frac{1}{2}$ cwt. The cubic content of each bucket is 3 $\frac{1}{2}$ cubic feet, and the average quantity of material brought up by each when working in sand is about 2 cubic feet. The number of buckets discharged per minute is 13 to 14 at the regular speed of about 6 $\frac{1}{2}$ revolutions per minute of the tumbler shaft.

The total quantity of material raised per day of ten working hours varies very much according to the nature of the material dredged. Where

the dredger No. 6 is at present working, about 1 $\frac{1}{2}$ mile below the river Leven, the rate of working is 150 tons per hour of the engine; while in hard ground the quantity may perhaps be only one half of this. Taking the entire work performed by this machine during last year, namely, 303,957 tons in 2,680 engine hours, the average work for a day of ten engine hours is 1,134 tons, or 113 $\frac{1}{2}$ tons per hour. The total quantity of material lifted by the two large dredging machines, Nos. 1 and 6, during the year ending 30th June, 1864, amounts to 336,752 cubic yards, of which about 250,000 cubic yards may be considered as due to maintenance, and the remainder to the permanent widening and deepening of the channel. The cost of dredging per cubic yard, taking the year ending 30th June, 1863, as performed by No. 1 dredger, was as follows, the dredged material being conveyed away by the punts:—wages, coals, stores, repairs, and 5 per cent. interest, 3'02 pence; repairs of punts, 1'59 pence; towing punts to and from place of deposit, 2'28 pence; discharging punts by waggons, 13'29 pence. Total cost of dredging per cubic yard, 19'18 pence. The cost of dredging as performed by No. 6 dredger during the same period, with the screw hopper barges for carrying away the material, was as follows:—Wages, coals, stores, repairs, and 5 per cent. interest, 4'06 pence; discharging by hopper barges, 2'30 pence; wages, coals, stores, repairs, and interest, 2'30 pence. Total cost of dredging per cubic yard, 6'36 pence. During this year No. 6 dredger was working near the two extreme ends of the river; and as during one half of the time it was attended by only two hopper barges in place of four, for discharging the material, much time was necessarily lost. This has since been rectified by the construction of additional barges.

The dredged material is disposed of according to two different modes. That filled into the 10-ton punts is towed down to some convenient part of the river, and discharged by barrows or waggons on to the banks or fields adjoining. That put into the screw hopper barges, shown in the engraving, fig. 3, is carried down to Looh Long, beyond the mouth of the Clyde, and deposited by opening the hopper doors U at the bottom of the carrying space W, as shown by the dotted lines. At the place where the deposit is made, the water is upwards of 200 ft. deep, and the mouth of the loch is about 37 miles below Glasgow; the hopper barges at present at work contain each 300 tons of dredgings, and steam from eight to nine miles per hour. This latter mode is by far the most economical way of disposing of the dredged material, as seen by the above statement of the cost by the two methods; and the result has been so satisfactory that two additional barges are now being constructed, each to be capable of carrying 400 tons, making six barges in all. In conclusion it may be mentioned that a larger and more powerful single dredger is now being constructed for the Clyde Trust by Messrs. A. and J. Inglis, of Glasgow. The dimensions of this dredger will be:—Extreme length, 157 ft.; extreme breadth, 29 ft.; depth, 10 ft. 9 in.; and bucket frame capable of working in upwards of 30 ft.

depth of water. The engine will be horizontal, with cylinder 44 in. diameter, and adapted for a 3 ft. stroke; the boiler will be tubular, and capable of working to 25 lbs. pressure per square inch above the atmosphere. The buckets will be 39 in number, discharging over the side; the pitch of the bucket-chain will be 30 in., and each bucket when quite full will contain $13\frac{1}{4}$ cubic feet. The flat bucket back with the double links will be made of malleable cast iron with the links cast solid upon it; this construction has been found to last without requiring repair for more than double the time of the ordinary backs with riveted links. The bucket rollers will not require spindles, as they will have necks cast on the ends of the rollers, which will answer for the spindles. The lower tumbler shaft will be of wrought iron having strong rings or hoops at the journals, so that when worn the hoops can be easily removed and replaced. The only other difference of any consequence from the present dredgers will be in using grooved frictional gearing for driving the hoisting barrel that lifts the dredging ladder instead of spur gearing with a friction wheel as previously described. The total cost of the dredger will be about £17,000.

APPLYING MOTIVE POWER TO SHIPS.

This invention consists in the application of a combination of steam and air as a motive power to ships and vessels of all descriptions. It has been patented by MM. Jean Baptiste Andreux and Eugène Coulon, both of 82, Boulevard Sébastopol, Paris. The improvements in the combination of steam and air are as follow:—A boiler of suitable size and shape is used, inside which is coiled a serpentine copper tube or pipe, through which steam is conducted to a second tube or pipe hereafter described; the steam in passing through this first tube is superheated by means of boiling water, steam, jets of gas, or other similar means. For the purpose of increasing the force the superheated steam is made to escape from this first tube by a small jet into a second tube whose mouth is slightly funnel-shaped and whose diameter is larger than that of the first tube; it is in passing from the first to the second tube that atmospheric air is introduced, the superheated steam drawing it into the second tube as it enters the funnel-shaped mouth; the other end of the second tube opens at the stern of the vessel. Other tubes may also lead from this second pipe to the sides of the vessel, the escape being so arranged that the steam strikes in a backward direction so as to aid in propelling the ship.

CLYDONICS.

By PROFESSOR S. D. TILLMAN.

In a former number we gave the first part of a paper on this subject, which was read before the Polytechnic Association of Philadelphia. At the last meeting of the Association the author, who is the President, read the following paper in conclusion of the subject:—The celebrated historian, Buckle, believed the most effective way of turning observations of natural phenomena to account, would be to give more scope to the imagination and incorporate the spirit of poetry with the spirit of science. By this means our philosophers would double their resources, instead of working as now, maimed and with only one half of their nature. They fear the imagination on account of the tendency to form hasty theories. But surely all our faculties are needed in the pursuit of truth, and we cannot be justified in discrediting any part of the human mind. These views, if not applicable to methods of original research, are certainly of great moment in considering the best means of diffusing scientific knowledge; and if there is any branch of philosophy which is pre-eminently entitled to bring to its surface the free play of fancy, it is that treating of the force of waves, whether propagated through liquids, aeriform fluids, or more attenuated media. A discourse on the structure of the flame of the ordinary lamp might not gain general attention, yet how intense the interest as we speak of the particular light which a captain seeks when his vessel, freighted with human beings midst storm and darkness, has nearly reached its haven. There are scattered along our vast boundary five hundred such beacons, kept in operation at an annual expense to the United States Government of more than a million of dollars. A description of one of these is given in the posthumous papers of the gifted Thoreau, just published under the title of "Cape Cod;" and, although since the time of his visit a more imposing structure has arisen in the place of the old lighthouse, the account is so graphic, one feels, after its perusal,

the satisfaction which he would probably have experienced by a personal inspection of the premises. The Cape Cod Light is a substantial-looking building of brick, painted white, and surmounted by an iron cap. Attached to it is the dwelling of the keeper, one story high, also of brick, and built by Government. The light consisted of fifteen argand lamps, placed within smooth concave reflectors twenty-one inches in diameter, and arranged in two horizontal circles one above the other, facing every way excepting directly down the Cape. These were surrounded, at a distance of two or three feet, by large plate-glass windows, which defied the storms, with iron sashes, on which rested the iron cap. All the iron work, except the floor, was painted white, and thus the lighthouse was completed. This house consumes about eight hundred gallons in a year, which cost not far from one dollar a gallon. Let us in imagination stand with Thoreau on the luminous tower and amid the agitations of ocean, air, and æth, consider the laws by which the presiding power controls these elements. The restless sea, through all its movements, from ripple to billow, obeys the same mandate; the time of each oscillation is proportional to the square root of the length of the wave. At great depths the motion of the fluid is wholly insignificant, because at a distance below, equal to the length of a wave, the motion is only $1/535$ th of that at the surface. The size of the wave depends, therefore, upon the force of the wind and the depth of the sea. The largest on the Atlantic observed by Captain Scoresby were 550 ft. long and 30 ft. high. The air, however, is not confined like the sea, which has only an upward and downward motion, except near the shore, where the force it contains would escape. But the whole mass of air moving as wind, has also a vibratory or wave-motion producing sound. If the distant bell we hear is tuned to middle C of the musical scale, according to the new French standard, and the temperature is at 16 deg. Centigrade, its sound is produced by air waves vibrating—not undulating—at the rate of 522 per second, each of which is about 2'15 in. in length. The lowest octave of this note which could be heard would, according to Savart, be the result of 1631 waves per second, each about 68'8 ft. long, and the highest octave by waves moving at the rate of 33'408 per second, each 0'492 of a foot in length. Turning now to the light produced by the fifteen argand lamps, we behold still more wonderful wave phenomena. The all-pervading æth is, for miles around, thrown into undulations moving at an average rate of 532 million of million per second, having an average length slightly exceeding twenty-one millionths of an inch. These numbers, determined by repeated experiment, appal us, and we turn to that branch of the subject where results are more palpable.

All the phenomena attending the artificial production of light is not yet fully understood. Light is only one of the effects of the burning of hydrocarbons in the gaseous state. The solid candle and the liquid contents of the lamp must be volatilised, and brought into the same expanded state as ordinary illuminating gas before they can be burned. This condition is attained, in the case of the candle, by the heat of the flame; the liquid wax or tallow, by capillary attraction, is carried along the wick to the point where it is turned to gas. Yet light does not emanate from gases. Draper found that while gases heated to over 1,100 deg. Centigrade do not give light, all the solids subjected began to be luminous at about 510 deg. C., and they display the several colours of the prism, and finally emit white light. In the process of burning illuminating gas, the hydrogen is first combined with the oxygen of the air, and the solid particles of carbon thus deserted by the hydrogen and exposed to the heat generated by the burning gases, become incandescent and afterwards unite with oxygen forming carbonic acid gas. It is, however, true that when the carbon is consumed at the same time with the hydrogen, no light is evolved; such condition exists when the oxygen is mechanically but thoroughly mixed with the hydro-carbon gas before it arrives at the place of burning. This is effected by the Bunsen burner, in which the air is admitted at the bottom and mixed with the gas on its upward passage within the burner. The result of this simultaneous burning of both carbon and hydrogen is an increased amount of heat and an almost entire absence of light. It seems, therefore, to be essential to the production of light, that the combustion of the carbon should take place after that of the hydrogen. Steel filings dropped into a current of heated gases give forth brilliant scintillations. Hare, soon after his invention of the hydro-oxygen blow-pipe, found that a pencil of lime held before it, in the burning gases, emitted a light of intense brilliancy. Such a light, when its rays were thrown into parallel lines by means of a parabolic mirror, has been seen in diffused daylight at a distance of more than one hundred miles. But to assert that light is generated because carbon or any other solid is incandescent, is not to explain the phenomenon. Light is proved beyond a doubt, to be the result of waves moving transversely to the

line of propagation; the solid from which it proceeds must, therefore, have the power of producing such waves in the æth. The interesting question to be settled is, whether the solid itself, or the æth within it, can be set into high vibratory action by means of waves of heat having a lower rate of velocity. Reasoning from analogy, we must decide in the affirmative.

Air waves have the power of exciting vibrations in solids which are more rapid than the waves producing them. This fact was brought forcibly to my notice many years ago, when I found the low tone in which I was conversing in a certain room was constantly followed, not by an echo, but by a musical note of very high pitch: after a search the sound was found to proceed from a sheet of steel six or eight feet long by as many inches wide, standing on its end, and resting against the wall. This sympathetic action can be accounted for by the laws of harmonics. The proper tone of a bell is always accompanied by harmonic sounds readily perceptible to a fine ear. It is asserted by some musicians that every sound made by a musical instrument is thus accompanied. The vibratory action arising from periodic pulses sometimes appears to be greater than the cause; this arises from the fact that a new impulse is given just before the force of the previous impulse is expended. The same remark may be applied to oscillations. In the gymnasium the self-swingers exert themselves only at the extremities of the arc. The danger of regular pulses where weight is sustained is well known. Soldiers in crossing a wooden bridge are required to break ranks and step out of tune. I have often seen the long span of a timber bridge, which was firm under the tread of a herd of cattle, thrown into quick vibration by the rapid passage of a dog across it. The condition required in this case is, that the tread of the dog shall harmonise in time with the vibratory action due to the elasticity of the timber. Many points connected with the subject of secondary vibrations are yet to be further elucidated by experiment.

Only one other cause for æth undulations by means of carbon can now be suggested; it arises from the characteristics and conditions of the three important simple bodies which play the principal parts during ordinary combustion. Oxygen, the element of which more than one-half of our globe is composed, when isolated, is a permanent gas. No power yet applied has reduced it to the liquid state. Hydrogen, a gas sixteen times lighter than oxygen, has also no cohesive power. Natterer, of Vienna, subjected these gases separately to a pressure of 3,000 lbs. to the square inch, when at a temperature of 106 deg. Centigrade below the freezing point of water, without producing cohesion. Yet these two gases, when mixed in the proportion of two volumes of hydrogen to one of oxygen, are, by the electric spark, instantly condensed to steam, and on cooling, to water. Carbon, on the other hand, when isolated, is always a solid. No amount of heat yet applied has brought it to a gaseous, or even a liquid state. In its most condensed condition, as the diamond—it had 3'55 times the specific weight of water; it is 41,890 times heavier than equal bulk of hydrogen, 2,618 times heavier than oxygen, and 2,993 times heavier than olefant gas (C^4H^4). In the process of illumination by the combustion of hydro-carbon gases, as described, the isolation of the carbon seems to be essential. It must, therefore, instantly change its volume, and become a solid, and then as quickly assume the gaseous state, in the formation of carbonic acid gas. These rapid contractions and expansions of carbon may act as pulsations on the pervading æth, and thus generate the whole series of waves, which, commingling, form white light. It is passing strange that carbonic acid gas, a resultant in generating light and heat—including the vital heat of myriads of animals—should, after its passage from the lamp or the lung to the leaf, be again separated from oxygen by a force similar to that its constituents can generate under certain conditions.

Turning again to the Highland lighthouse, let us estimate the power expended on its lamps. The average weight of oil consumed nightly was about 16 lbs. at the time of Thoreau's visit. Taking the mean of the results of experiments by Favre, Silbermann, Dolons and Andrews, with olefant gas (oil-gas not being given), we find that 11,943 lbs. of water are raised 1 deg. C. by the combustion of 1 lb. of oil. This sum multiplied by 16, the number of pounds used per night, and that product by 1,390 the number of foot-pounds which measures the force expended in raising 1 lb. of water 1 deg. C.—that being the mechanical equivalent of heat as correctly determined by Mayer in 1842—we have 265,612,320 foot-pounds as the amount of energy expended in generating the light required for a single night. In order to fully appreciate the power of these molecular forces, it is only necessary to refer to Dr. Tindall's admirable work on "Heat as a Mode of Motion." After calculating the mechanical value of the energy developed when the atoms of 1 lb. of hydrogen and 8 lbs. of oxygen attract each other, fall, and clash together, when the

molecules of steam thus generated condensate water, and this water is converted to ice, the author says:—"Thus our 9 lbs. of water, in its origin and progress, falls down three precipices; the first fall is equivalent to the descent of a tun weight, urged by gravity down a precipice 22,320 ft. high; the second fall is equal to that of a tun down a precipice 2,900 ft. high, and the third is equal to a descent of a tun down a precipice 433 ft. high. I have seen the wild avalanches of the Alps which smoke and thunder down the declivities with a vehemence almost sufficient to stun the observer. I have also seen snow flakes descending so softly as not to hurt the fragile spangles of which they were composed; yet to produce from aqueous vapour a quantity of that tender material which a child could carry, demands an exertion of energy competent to gather up the shattered blocks of the largest avalanche I have ever seen, and pitch them to twice the height from which they fell."

Such is the impressive estimate of the force expended in the formation of 1 lb. of ice from its component elements in the gaseous state; yet it will be observed, by the figures already presented, that the energy developed in one nocturnal display of the Highland beacon was sufficient to have thrown the fragments of five such avalanches to the same height. Thoreau, the student and lover of nature in her wild moods and original garb, doubtless, with mingled feelings of awe and delight, beheld from that beacon-tower the surging of the sea, and heard in sullen sounds, the threatenings of a tremendous force; but as he turned toward the light, which fixed the gaze of many an anxious mariner, he did not realise the truth that Art had there trained Nature to perform the common service which must ever be regarded as one of her greatest miracles; and that, to guide the sailor along the dangerous coast, she sent forth her messengers of light amid the ambient æth, whose undulations, in each and every minute of time, outnumber all the ocean waves that have culminated since man first ventured on the deep.

Correspondence.

THE ATLANTIC TELEGRAPH.

TO THE EDITOR OF THE "MECHANICS' MAGAZINE."

SIR,—Will the present, the second Atlantic Telegraph Cable be a success? Certainly not; and for very obvious mechanical reasons. The outer spiral wires, instead of being strengtheners, are weakeners, still more than were those of the first cable, which consisted of 18 strands of 7 wires each, the untwisting of the 18 strands, when in strain, being in part counteracted by the opposite twist of each strand. In the second cable, the 10 surrounding spiral wires are of single homogeneous iron, that is, one strand each—no counter-twist—the unwinding quality unchecked, for the covering of each wire with manilla is aside from the subject. But the coiling a hard material around a soft, not foreseeing that the strain must result in the disintegration of the core, is surely blundering the most absurd. Let anyone interested in the matter take a piece of twine, say a yard long, weight it with a third or a half its breaking strain, and watch its unwinding and stretching, and notice, also, that, notwithstanding the two ends being held fast, the untwisting process still takes effect wherever the string is weakest. Then let him carry his thoughts to the 8 or 10 miles of cable, which in the paying out will be in suspension at one time. The breaking strain of the cable is 7½ tons, its weight in water per mile 14 cwt.; 10 miles therefore will be 7 tons; if the cable does not break, the core must be irretrievably ruined.

How might this have been prevented? by the outer wires being made strengthening wires, taking the entire strain; by being laid lengthways with the cable, merely sufficiently spiral to permit coiling in the ship. Strength is the object to be attained by these wires, freeing the core from all strain, and only thus can this be accomplished. In an inch and half specimen now before me, the spirality measures 3-8th of an inch, that is, 3 in. in a foot, one circumference, the diameter being an inch; 4 miles of the cable will, therefore, be 5 miles where the outer wires are straightened in the strain; the core requiring stretching out one in four, which stretching-out cannot possibly be accomplished equally throughout, but must tell the most on the weaker parts; and although copper will give, and gutta-percha will give, yet the parts giving way the most will probably in places admit the sea water, and possibly in places permit contact between the copper wires and the iron wires, to the destruction of the electrical continuity: the cutting in on the core of the outer wires in coil being still likelier than the straightening to do the damage.

What good mentioning this now the cable is made? For the benefit of the third cable, and of all other deep sea cables hereafter. Faith and hope now being supreme, the revulsion of failure will call the keener attention to its cause. Would it not have been better to have called attention to this before the cable was begun? I did: I wrote to Lord Palmerston on the occasion of agents having

been sent from the American Government to the British Government, proposing a guarantee to the shareholders for the purpose of resuscitating the Atlantic Telegraph Company; to this letter I had no reply, and after some ten days I wrote again, the same words, with the same result. The following is the copy of my letter:—"Brighton, 2, Marshall's-row, March 7, 1862. My Lord Palmerston,—The desiderated perfection of the Ocean Telegraph Cable will be this:—That the outer wires be laid lengthways, instead of spirally; say thus, the inner wires slightly twisted, covered with india-rubber; next, a coating of gutta-percha, then india-rubber; around that the outer strengthening wires laid close together, lengthways; then a coating of gutta-percha; over that, say some yarn spun; there will be no untwisting nor cracking of the materials, and, however simple and obvious this appears when stated, yet, published, adopted, and successful, it should yield some recompense to the discoverer.—I am, my Lord, your obedient servant, William Wright." Nevertheless, a commission was appointed which planned the present cable, which, I fear, will soon prove to be a total failure.

I am, Sir, your obedient servant,

WILLIAM WRIGHT.

2, Marshall's-row, Brighton,
July 12, 1865.

SIR,—Already are we having mistrust expressed for the success of the working—even if successfully laid—of the splendid Transatlantic cable. If the vast span of the Atlantic be beyond human powers to overcome at one reach, why not divide it and by that means conquer the difficulty. There are five or six comparatively shallow beds in the space where the separate divisions of a cable could be brought to, and where they could be connected at the surface. If the present great effort fail, and I have always feared it would, there then remains to be done what I have so frequently suggested as the only means of overcoming the difficulty, viz.: to divide the cable into parts as many or few as the case requires.

I am, Sir, yours,

C. PENRYN ASTON.

Charles-street, Fulham-road, S.W.,
July 18, 1865.

FLYING MACHINES.

SIR,—The last week's number of the *MECHANICS' MAGAZINE* contains an account of a flying machine having been constructed at Hoboken, N.Y., under the direction of the United States Government. That being so, and I happening to be one of the enthusiasts mentioned in the article, I beg you will spare me a small space in your Magazine to state that I have considered long since the art of flying to be obtainable; but, as I am not in possession of the means which I deem necessary to carry out my ideas practically, I can only express them. I deem the best method to obtain decided success is by a maximum power in conjunction with a minimum of weight. Confiding in these rules, I think the whole weight of the machine should not exceed two tons, including two men to navigate it; but, should a flying machine on this small scale prove eminently successful, I will not say that a machine on a larger one could not be made to carry a weight of six tons or even more, and should the Hoboken machine prove a success, the trying it experimentally on a small scale would be unnecessary.

I am, Sir, your obedient servant,

Brighton, July 18, 1865.

M. S.

RECENT IMPROVEMENTS IN THE STEAM ENGINE.

SIR,—Your notice and review of the above work in your valuable journal of the 14th inst. I have read with care and attention, the more so from having purchased the work and been greatly disappointed in it; and also at finding, instead of being a scientific work got up in a proper manner, and in a way commensurate with the reputation as a scientific writer hitherto maintained by Mr. Bourne, that it is nothing more than a "cook-up" of the different price-lists and illustrated catalogues of those makers who have favoured Mr. Bourne with the use of their engraved blocks, and in which also many "recent improvements," or at least some equally as recent as many of the examples given, are entirely omitted!

For instance, we find very liberal use made of the illustrated price-list and catalogue engravings of Messrs. Carrett and Marshall's donkey pumps and other contrivances, whilst the only other donkey noticed is that of Messrs. Hawthorn; then we find a centrifugal pump, and one of the least efficient it may be remarked, well described and puffed, whilst all other pumps of this description, one of which at least is far superior to the example quoted, are entirely omitted and unnoticed. Then we have a description and engraving of a double cylinder expansion engine, which is notoriously one of the least efficient of this kind of engine. Next, we have the steam cranes and winches of one maker

only described and illustrated, it being well known that several firms make most excellent machines of this description, in many of which several ingenious and useful forms and plans are adopted, but none of them are alluded to in the slightest degree. In steam hammers many again are described, and at least one simple and good form, which is in extensive use, is passed over without notice. The steam engines made by one large firm in the north, for screw and paddle engines, which have been very conspicuous for their economical and successful working over a considerable period, are also not alluded to, nor are the various modifications and improvements in the oscillating engine, as applied to screw and paddle engines, except in one instance, at all noticed.

In steam ploughing, also, one or two well-known systems which are in extensive use are unnoticed, and the example selected is at present one of the least employed. With the remarks on a rotary digger I perfectly agree, having seen in use just such a machine as is required, which is now on exhibition at the Agricultural show at Plymouth. I allude to Canstock's rotary spades, an American invention recently introduced, which bids fair to become of extended employment, it being very simple and very efficacious. The machine of Romaine, alluded to in your notice of this book, was built on a principle proved to be entirely wrong, which was quickly shown in practice when set to work.

At the end of the work we find large use made of the illustrated circulars and descriptions of the makers of steam fire engines, with various critical remarks thereon, which unfortunately have not the slightest value, from the evident want of a proper acquaintance with the subject; indeed, after a careful perusal of them, I am irresistibly led to the conclusion that the author never saw a steam fire engine at work! The origin of the steam fire engine is entirely omitted, the invention of different plans erroneously attributed, things called by the wrong name—for example, the nozzle attached to the end of the branch pipe is called a "spout pipe;" and *ex cathedra* opinions are pronounced which practice continually proves to be totally incorrect. But this is not all, for in the concluding pages the description of a passenger steam carriage for common roads is actually given as that of a well-known land steam fire engine! It is to be hoped that the new work on steam fire engines, whose advent was announced in your valuable journal a short time since, will not betray a similar want of knowledge on the subject, and I trust that in the future Mr. Bourne will see that the character and reputation he has so well earned as a scientific writer should not be imperilled by the use of scissors and paste, a flagrant example of which we have recently had in a monster illustrated catalogue which disappointed so many, and so miserably failed to realise the expectations raised at its announcement.

It is to be hoped that scientific writers will not fall into this grievous error, but that in future they will honestly set to work to redeem their already imperilled, if not seriously damaged, reputation. In this hope I beg to subscribe myself,

Yours obediently,

AN OLD SUBSCRIBER.

London, July 15, 1865.

TO CORRESPONDENTS.

The *MECHANICS' MAGAZINE* is sent post-free to subscribers of 21 ls. 8d. yearly, or 10s. 10d. half-yearly, payable in advance. Post-office orders made payable to Mr. E. A. Brooman, of 166, Fleet-street, E.C.

Advertisements are inserted in the *MECHANICS' MAGAZINE* at the rate of 6d. per line, or 54d. per line for 6 insertions, 4d. per line for 13 insertions, 44d. for 26 insertions; and 4d. a line for 52 insertions. Each line consists of about 10 words. Woodcuts are charged at the same rate as type. Special arrangements made for large advertisements.

All communications should be addressed to the Editor, 166, Fleet-street.

To insure insertion in the following number, advertisements should reach the office not later than 5 o'clock on Thursday evening.

We must absolutely decline attending to communications unaccompanied by the name and address of the writer, not necessarily for insertion, but as a proof of good faith.—Ed. M. M.

RECEIVED.—F. W.—J. H.—J. M.—E. W.—J. H. E.—J. H.—Messrs. M. and Co.—G. W.—A. F.—Capt. S.—W. H.—O. W.—A. W.—O. P. A.—J. H.—O. and P.—G. O. O.—J. W.—A. R. M.—G. J. N.—M. C.—G.—W. W.—A. R.—C. F. H.

ANSWERED BY POST.—G. H.—W. H. H.—A. W.—W. H. P.—W. H.

Miscellaneous.

We have received a letter from Mr. James S. Harvey, honorary secretary to the "Buckle Memorial," enclosing a list of subscriptions received on account of the fund now being raised for the purpose of erecting a suitable memorial to the late Mr. William Buckle. We have already brought

this matter before our readers, and can only add that subscriptions may be paid to the treasurer, W. Dempsey, Esq., 26, Great George-street, Westminster. The following are the subscriptions received:—M. P. W. Boulton, Esq., £50; W. Bruntoun, Esq., £2 2s.; Joseph Newton, Esq., £1 1s.; Thomas Penn, Esq., £1 1s.; Joseph Taylor, Esq., £5; J. P. Smith, Esq., £3 3s.; Isaac Smith, Esq., £1 1s.; G. R. Stephenson, Esq., £3 3s.—Total, £66 11s.

Mr. W. H. Preece's system of electric signalling, which is in operation on the South-Western Railway, has just been adopted on the Glasgow and Paisley joint line. This is the first application of the "block system" upon this principle in Scotland, and such is the safety insured by it and the satisfaction it gives to signalmen and drivers that it cannot fail to meet with extended application.

There is a rumour in Portsmouth, founded on what is considered to be reliable authority, that the French squadron of ironclads will, with the English ships, go to that port after their visit to Plymouth. We understand that the principal naval and military officers are already suggesting balls and entertainments, and it is believed that the municipal authorities will also give a liberal reception to our Gallio neighbours.

Some new prizes are announced by the National Rifle Association for competition with cartridges made up with Dr. Erhardt's newly-invented powder. Seven-eighths of a dram of this powder is sufficient for the Enfield instead of the 2½ drams charge of gunpowder which constitutes the service charge. One valuable peculiarity of the powder is that the two constituents of which it is composed can be kept separate with perfect safety. It is not until they are mixed that an explosive powder is formed. Government engineers, who have been blowing up a portion of the Pin Rock, at Dartmouth, speak highly of its strength and value for blasting purposes. The competition will go far to show in what degree it is suitable for small arm cartridges.

There was lately shipped to the Charleston Navy Yard an oak log 59 ft. long and averaging 36 in. square. It contained 531 solid feet of sound wood, and material for 6,272 ft. of inch plank. It weighed 18 tons, and was brought from Ohio in a raft of timber via the Erie Canal.

The foundation stone of the new bridge at Blackfriars was laid yesterday afternoon by the Lord Mayor, assisted by the Corporation authorities, who surrounded the event with as much pomp and circumstance as their opportunities allowed. As is usual in England upon the transaction of any matter of business great or small, the event was celebrated by a civic dinner at the Mansion House, in the evening. The new bridge is estimated to cost £320,000, inclusive of the cost of the temporary wooden structure.

Heretofore the clay for crucibles has been imported by all the American glass works either from Germany or from Stourbridge, in England; it is worth 25 dollars per ton in gold in that market, and a single manufactory will consume 300 tons a year. But a large deposit has been found near St. Louis, in Missouri, which from analysis and practical trial is pronounced fully equal to the best English or German clay. This is another important step in the development of the mineral resources of the country.

It is a remarkable fact that one of the most abundant materials in nature—iron, is the strongest of all known substances. Made into best steel, a rod one-fourth of an inch in diameter will sustain 9,000 lbs. before breaking; soft steel, 7,000 lbs.; iron wire, 6,000 lbs.; bar iron, 4,000 lbs.; inferior bar iron, 2,000 lbs.; cast iron 1,000 lbs. to 3,000 lbs.; copper wire, 3,000 lbs.; silver, 2,000 lbs.; gold, 2,500 lbs.; tin, 300 lbs.; cast zinc, 180 lbs.; sheet zinc, 1,000 lbs.; cast lead, 55 lbs.; milled lead, 200 lbs. Of wood, box and locust, the same size, will hold 1,200 lbs.; the toughest ash, 1,000 lbs.; elm, 800 lbs. beech, cedar, white oak, pitch pine, 600 lbs.; chestnut and soft maple, 650 lbs.; poplar, 400 lbs.

According to the *Courrier de Bretagne*, an interesting experiment was made at Belle-Isle last week to fish at night by means of the electric light. The light was produced by a powerful electro-magnetic machine constructed by M. Basin. The experiment was conducted by M. Basin on board the "Andalousie," and was completely successful, the quantity of fish taken being very large. As soon as the submarine lantern was immersed shoals of fish of every description came to sport in the illuminated circle, while the fishermen outside it spread their nets from their boats. M. Basin is shortly to proceed to Bona, in Algeria, to establish a coral fishery by the assistance of his electric light.

The production of pig and manufactured iron in this country has been considerably increased of late by the erection of new furnaces and mills on the east coast and in other new mining districts. This has created a large supply and increased competition, which will tend to moderate any advance in prices.

Russia is said to be realising a grand success in the Moscow Exhibition of Industry. Among the products of Russian national industry which excite considerable interest, furs, plate, and sundry articles of gold and silver are given prominence to in the Russian papers. Costly porcelain and vases of jasper, agate, and other (chiefly Siberian) minerals are also enumerated as so many triumphs of the national art. Of raw materials are mentioned specimens of Crimean cotton, Caucasus petroleum, flax, hemp, tallow, dyes, varnishes, and the other staples of the Russian market. Agricultural machines have been chiefly exhibited by English and German firms established in the country. On the whole the present exhibition seems to be the finest ever witnessed in the country.

We understand that the French Government has just announced the renewal of the grand prize of 50,000 francs to be given, in five years time, to the author of a discovery which shall render the voltaic pile economically applicable as a source of heat, as a means of lighting, or otherwise, in chemistry, mechanics, or medicine. The prize was awarded, in September last, to M. Ruhmkorff, for the well-known apparatus that bears his name. Should no invention deemed worthy the honour be brought forward within the time specified, the period may be prolonged for another five years by decree.

The iron-cased frigate "Lord Warden," 24, 1,000-horse power (nominal), after shipping her iron masts, boilers, and other heavy portions of her machinery, has been floated into the vacant dock formerly occupied by the "Bellerophon," to have the remainder of her armour plates bolted to her sides, and to be equipped for sea, an operation which will detain her from four to six months. The cleaver which she will carry in front of her projecting stem has been successfully cast; its weight is nearly eight tons.

The consumption of Ceylon graphite by the Plumbago Crucible Company at their works at Battersea, has had an extraordinary effect upon the price of the article. When the company commenced business it cost about £10 per ton, but now it cannot be bought at double that price. In Ceylon applications to dig graphite are daily on the increase, notwithstanding the rate of 14s. per ton which has to be paid as royalty at the Colombo Cutcherry.

Recent analyses, made according to Bunsen's method, show the composition of the gas of some cities on the Continent to be as follows:—

	Heidelberg.	Breslau.	Bonn.
Hydrogen . . .	41.05	40.70	39.80
Marsh gas . .	40.71	39.52	43.18
Carbonic oxide .	7.64	4.01	4.66
Condensable hydrocarbons }	7.28	4.96	4.75
Carbonic acid .	0.58	0.41	3.02
Nitrogen . . .	2.75	10.10	4.65

The following ingredients are said to form an indelible black ink to be used for writing on zinc:—Take 30 parts of verdigris, 30 of sal-ammonia, 8 of lamp-black, 8 of gum arabic, and 300 of water; dissolve the gum in the water, and pour it over the other ingredients, well mixed and reduced to powder. A quill pen should be used for writing.

New discoveries of coal continue to be made in Nova Scotia. One seam, 30 ft. thick, has been found adjacent to the lands of the General Mining Association, and others near New Glasgow.

The United States Telegraph Company, whose wires already extend over 18,000 or 20,000 miles in the Atlantic States, have contracted for a two-wire line of telegraph from St. Louis and Chicago to San Francisco. The lines from the eastern cities named to Denver City, and from San Francisco to Virginia City, are to be finished this autumn, and the whole line is to be completed in the autumn following.

The "Bellerophon," 16, 1,000-horse power, in addition to carrying ten 300-pounders, is to be provided with five 110-pounder rifled Armstrongs on her main deck. She is being brought forward for commission with all despatch.

In an ancient work the following recipe for the treatment of ivory occurs. To soften ivory place it in three ounces of spirits of nitre and fifteen of spring water, mixed together; let it soak three or four days, when it will be soft. To dye ivory thus softened dissolve in spirits of wine such colours as you want, and when the spirit of wine is sufficiently tinged, plunge the ivory in it, and leave it there till penetrated with it. Then give the ivory what form you please. To harden it afterwards, wrap it up in a sheet of white paper, and cover it with decrepitated common salt, crumbled by heat, and as dry as it can be; in which situation leave it twenty-four hours.

A continental paper states that a fossil man has just been dug up in a bed of drift between Veyziat and Oyonnax, near Nantua (Ain). The body was found in an inverted posture, but the bones did not adhere together, but were brought out one by one. The matter will probably be brought before the Academy of Sciences.

It may interest those engaged in the iron bedstead manufacture to know that competing rivals in Italy are making rapid headway. Bedsteads are now being produced there combining the most beautiful artistic finish with remarkable cheapness of production. The Italian makers have certainly the advantage of cheap labour, but their greatest acquisition is an essentially art-loving people, a characteristic which, among English artisans, is for the most part conspicuous by its absence.

Mr. Smiles has conceived the happy idea of writing the joint biography of Matthew Boulton and James Watt, whose high qualities combined gave Great Britain the illustrious firm of "Boulton and Watt." We understand that the present representative of the Boulton family, M. P. W. Boulton, Esq., of Tew Park, has given Mr. Smiles full access to the Soho papers, and to the extensive original correspondence between Boulton and Watt, so that an authentic history may be looked for; and Mr. Percival Skelton, a competent artist, has recently been in the neighbourhood, making drawings of many objects of interest connected with the Soho firm; one of the most curious of which is an accurate representation of Watt's private workshop at Heathfield, as it was left at his death forty-six years ago, the room having been opened only for the third time, a few weeks since, to enable the drawing to be made, by permission of J. Gibson Watt, Esq.

The minerals of Cleveland are being further developed by capitalists from Newcastle and elsewhere. The Brotton Ironstone Royalty—a stone yielding from 32 to 35 per cent. of iron in the raw condition, a high percentage for stone of this class, and as yet the richest obtained in the Cleveland district—is being extensively worked by Mr. B. Morrison, of steam-hammer celebrity, Newcastle; and Messrs. Bell Brothers, of the Clarence Iron Works, are making arrangements to work the same seam. Limestone is receiving its share of attention, very large royalties having been taken by private companies for the purpose of supplying first-class limestone at prices 15 per cent. under present rates.

Messrs. Pardee and Co., at Hasleton, Pa., are now working what is considered to be the deepest coal mine in the United States. It is situated on the land of the Diamond Coal Company, and is known as the "Sugar Loaf Slope." It is 970 ft. in perpendicular depth, which is below the surface of the Lehigh river at Ten Haven. The slope is in the neighbourhood of 3,000 ft. in length. The mine has been worked successfully for nearly thirty years.

It is stated by several agricultural journals that by watering plants with sulphate of iron most extraordinary results may be obtained; beans, for instance, will grow to double their size and acquire a much better taste; the same is the case with pears and other fruit. Water kept in a tub with a quantity of old nails in it may also be used for watering with good effect.

Two fine new lifeboats, built by Messrs. Forrest and Son, of Limehouse, on the plan and under the superintendence of the National Lifeboat Institution, for the French Shipwreck Society, have just been forwarded to the French coast. Each boat is 32 ft. long, rows ten oars, and is in every respect like the medium lifeboats of the English institution.

Messrs. Winans Brothers, an American firm, have recently entered into a contract with the Emperor of Russia, for working and keeping in order the railroad between St. Petersburg and Moscow, one of the greatest works of the kind in Europe, and which was originally built and stocked by them. The new contract is for eight years, and they are to receive eight millions of roubles per annum for the work.

The "Japan," a steamer of 600 tons burden, 180 ft. by 26 ft. and 15 ft., built for the East India trade by Messrs. Hedderwick and Co., of Govan, has made a trial trip between the Cloch and Cambræ Lights. The steamer, which is fitted with a pair of direct-acting engines of 86-horse power (nominal), by Messrs. J. Howden and Co., "ran the lights" in 51 minutes, being at the rate of 10.12 knots per hour. The "Waverley," built by Messrs. A. and J. Inglis, for the North British Steam Packet Company, has also made a trial trip, in which the highest speed attained was 14½ knots per hour, reckoned by a patent log. The "Waverley" will run between Sillioth and Dublin, in connection with the North British Railway. She is a vessel of 735 tons builders' measurement, measures 26 ft. 6 in. breadth of beam and 220 ft. length of keel. She has commenced working.

The State Prison in Maine earned 4,000 dollars more than its expenses last year. The institution has proved so profitable that the State authorities propose to build another one.

A new reservoir is about to be constructed in Cowes, Isle of Wight. Mr. Manwaring has taken the levels, for the purpose of getting out an estimate for the structure.

The *Halifax Express* says:—"We were shown by Mr. Buckner, agent for the German Company's Gold Diggings, of Waverley, an ingot of gold, weighing 445 ounces, the result of eight days' crushing. This company has been very successful, having taken out in twelve weeks 2,800 ounces. This compared with the famous Colorado mines, speaks well for Nova Scotia. At the latter place but 1,700 ounces were taken out in ten weeks with 42 stampers, while in this province we have the results as stated above with only 16 stampers."

The coal trade is steadily increasing in Rhonda Valley, and several collieries have been established during the last two years, many of which will be able to send to the markets six or seven hundred tons a day. The population increases considerably every year, and in a few years hence the valley will contain two or three large and populous towns.

An Indian Engineer officer, Lieut.-Colonel Fraser, R.E., has recently succeeded in erecting a lighthouse in the Bay of Bengal, under circumstances more difficult than are generally met with on our English coasts. The lighthouse is a most elegant structure, built of granite, from the Burmese coast. Its first-class revolving light was exhibited for the first time on the 23rd of April. It is 144 ft. above high-water mark, and is visible at a distance of 20 nautical miles.

A first-class new iron screw steamer, built and engined by W. Simons and Co., was, on Tuesday, launched from the London Works, Renfrew. This fine vessel is of 900 tons and 120 horse power, is named the "Count Van der Boesh," and is the property of the Netherlands Steam Navigation Company. Her decks and fittings are of East Indian wood, and she has full poop, fitted up with elegant cabins in rosewood, teak, and maple. The same builders have, far advanced, another steamer for the same company.

Patents for Inventions.

ABRIDGED SPECIFICATIONS OF PATENTS.

The Abridged Specifications of Patents given below are classified, according to the subjects to which the respective inventions refer, in the following Table. By the system of classification adopted, the numerical and chronological order of the specifications is preserved, and combined with all the advantages of a division into classes. It should be understood that these abridgements are prepared exclusively for this Magazine from official copies supplied by the Government, and are therefore the property of the Proprietors of this Magazine. Other papers are hereby warned not to produce them without an acknowledgment:—

BOILERS AND FURNACES.—3255
BUILDINGS AND BUILDING MATERIALS.—3250—1
CHEMISTRY AND PHOTOGRAPHY.—3256—3, 12, 13
CULTIVATION OF THE SOIL. including agricultural implements and machines. —None
ELECTRICAL APPARATUS.—22
FIBROUS FABRICS, including machinery for treating fibres, pulp, paper, &c.,—3253—7, 21
FOOD AND BEVERAGES, including apparatus for preparing food for men and animals. —None
FURNITURE AND APPAREL, including household utensils, time-keepers, jewellery, musical instruments, &c.,—3238, 3244, 3246, 3257, 3258—2, 13, 17, 24
GENERAL MACHINERY.—3242, 3248, 3249, 3251, 3254—8, 11, 15, 25
LIGHTING, HEATING, AND VENTILATING.—3245—4, 5, 23
METALS, including apparatus for their manufacture. —None
MISCELLANEOUS.—3241, 3252—20
ROADS AND VEHICLES, including railway plant and carriages, saddlery, and harness, &c.,—3243, 3259—6, 14
SHIPS AND BOATS, including their fittings. —None
STEAM ENGINES. &c.,—3239, 3247, 3260—18
WARFARE.—3240

3238 J. H. JOHNSON. *Improvements in sewing machines.* (A communication.) Dated December 29, 1864.

This invention relates to that class of sewing machines in which two spools are employed for making the lock chain or embroidery stitch with the same machine at the choice of the operator, and the improvements apply solely to that portion of the mechanism or apparatus which is contained underneath the table or base plate of the machine, the upper works being arranged in any well known or suitable manner. Beneath the base plate or table is situated a horizontal driving shaft, which has attached to one end a slotted and grooved cup revolving with the shaft, and provided with a hook on its outer edge which seizes the loop of the needle thread by passing in front of the needle. A slot is cut through the cup extending clear to the edge or rim, and a groove is also cut round the interior circumference of the cup near its front edge. This cup is provided with a guard which extends round its outer edge. An elastic metal thread controller or "take-up" is fixed to the back of the cup. The lower thread when used is supplied like the upper one direct from an ordinary spool, which is carried in a spool case of an annular form, having a bar across it with a slot at each end, and is further provided with a tension spring under which the thread passes on leaving the spool. This spool case is connected by a screw to a frame or ring, which fits into the annular groove made inside the slotted up, and when a fresh spool is to be inserted the spool case is detached from the frame by turning the coupling screw. A hook or projecting arm stands out horizontally from the back of the frame at its lower side, upon which the loop catches, and is held during part of a revolution of the cup. The spool case holder, which prevents the spool case from revolving, consists of two cranked rocking shafts, provided each with a lever or projecting arm, which arms are operated upon alternately by a cam or wiper on the driving shaft, and thus receive a slight reciprocating or rocking motion. To each rocking shaft is also fitted a second arm or projection, which arms alternately enter the corresponding slots in the cross bar of the spool case, and thereby hold it and prevent it from turning. The free pas-

sage of the loop over the spool case is allowed for by the withdrawal of the arms or projections from the slots just at the time the thread is passing, after which they enter their respective slots again. *Patent completed.*

3239 W. NALDER and A. BELCHER. *Improvements in steam engines and apparatus connected therewith, and with steam boilers, parts of which improvements are applicable to machinery in general.* Dated December 29, 1864.

This invention relates, firstly, to a novel arrangement of the education port or ports of the cylinder of a steam engine and of the piston to be employed therewith, with a view to the obtaining of greater economy in the construction and working of the engine; the education port opens directly from the longitudinal centre of the cylinder, or two ports may be made, one on each side of the centre, and the opening or openings thereof may be made to extend round the whole or any portion of the inner circumference of the cylinder. The piston is to be made of any convenient depth or thickness according to the portion of the stroke at which the education port is to be opened; but the patentees prefer to make it of such a thickness as to nearly fill up the portion of the cylinder between the end cover and the education port when one port is used, so that, just before it arrives at the end of its stroke it will open fully the education port by uncovering the same. When two ports are used, the length of the piston should be equal to, or nearly equal to, the half length of the cylinder. Secondly, to an improved construction of governors or regulators for steam engines of all kinds, and to a peculiar arrangement of the regulating valve actuated thereby. Thirdly, to an improved construction of feed pump, whereby simplicity and economy are combined with greater certainty of action. In this pump they make the stop-cock for the suction pipe elongated, in order to form the seat for the lift valve, which is situated on the side of the plug farthest from the suction pipe. Fourthly, to an improved construction of connecting rod applicable to feed pumps and valve motions. This rod is made flexible at one part by being flattened out at such part, or otherwise made elastic and flexible at the part required. This rod may either form a continuation of the pump rod, or valve spindle itself, or it may be rigidly secured thereto, and to the eccentric ring, thus dispensing with joints which are always liable to wear. Fifthly, to an improved construction and arrangement of the fulcrum levers and springs for safety valves of steam boilers, whereby greater sensitiveness is obtained. Sixthly, to an improved mode of lubricating the crank bearings of steam engines, which may also be applied to other bearings. This is effected by employing a brass, which is so formed as to hold the lubricant within itself at one or both ends thereof, an annular channel or chamber being made in one or both ends of the brass to contain the oil or other lubricating fluid. In this channel or chamber revolves an enlarged ring or collar, which is fitted to or formed in the journal. When in motion these collars take up the oil and distribute it over the bearing, but when at rest the oil flows back again into the channel or chamber. By this mode of lubricating a considerable saving of oil is obtained. *Patent completed.*

3240 R. CAILL. *Improvements in projectiles.* Dated December 29, 1864.

This invention consists in constructing shot, shell, and other projectiles with spiral sinkings or grooves on the sides and rear, to be acted on by the gas in the gun in order to impart rotary motion thereto. The inventor fits to projectiles, when in the form of cylinders, a loose end at the rear, which will fall from the projectile after leaving the gun, and the air will pass through the cylinder; or the projectile may be solid. *Patent abandoned.*

3241 P. O. P. L. PREFONTAINE. *Improvements in warehousing or storing liquids and other goods.* Dated December 29, 1864.

This invention applies more especially to storing hydrogenised liquids, either volatile or fused, such as oils, essences, spirits, and the like, and essentially consists in immersing in water the vessels containing the liquids to be stored. The vessels may be constructed in various ways. *Patent completed.*

3242 B. BAUGH. *New or improved machinery to be used in the manufacture of enamelled wares.* Dated December 29, 1864.

The patentee claims, first, machinery in which the powdered glass or enamel is carried in a hopper or receptacle travelling over the articles to which the enamel powder is to be applied, the enamel powder being shaken from the said hopper by a series of blows given to the said hopper. Also the modification described of the said parts. Secondly, machinery in which the articles to which the powdered glass or enamel is to be applied are supported on endless hand having an intermittent motion, the powdered glass or enamel being dredged on the articles by means of an inclined sieve having a vibratory or reciprocating motion. Also the modification described of the said parts. *Patent completed.*

3243 E. SHUFFLEBOTHAM. *Improvements in girders for railways and for other purposes.* (A communication.) Dated December 30, 1864.

This invention relates to such girders for railway and for other purposes as are composed of top and bottom members and end stanchions, the said parts being connected together by diagonal struts and ties, the object of the said invention being to facilitate the putting together of the parts of the girder, and to dispense with, when desirable, the use of rivets. The invention consists, first, in the following manner of framing the diagonals:—Each of the diagonals acting as the struts consists of two bars, whilst each of those acting as the ties consist of one bar, the said tie bars passing between the two bars of the struts. The said ties and struts are bolted together at their junctions by means of a cast-iron plate on each side, the said plates being bored out to fit on to the diagonals forming the said struts. The invention consists, secondly, in the following manner of fixing the ends of the diagonals to the top and bottom members of the girder. The top and bottom ends of the diagonals are provided with a box or shoe; one end of this shoe is prepared with an abutment to receive the diagonal bars acting as struts, and the other end is prepared with a mortice to receive the end of the diagonal bar acting as the tie. A space is left between the ends of the diagonals and the bottom of the box or shoe, which space is filled in with iron cement, and the said box or shoe bolted to the diagonals with bolts and nuts. The invention consists, thirdly, in the following manner of making the stanchions at the extreme ends of the girder. These stanchions are made of wrought-iron plates, and fitted up with one top distance piece, the said distance piece having flanges for connecting the said piece to the upper member of the girder. At mid height of the stanchion a cast-iron dis-

tance piece is fitted in the said piece, forming seats for the diagonal struts and tie bars, and the bottom ends of the stanchion plates are bolted to a cast-iron base. The invention consists, fourthly, in the following manner of fixing the cross joints of the girder. The cross joints are passed through between the diagonals, having an iron bearer underneath sitting transversely on the tie bars. This bearer is made with a raised part in the middle of its length to ensure the weight from the cross joints to pass through the axis of the girder. When the girders are made in pairs, they are coupled together by cast-iron distance tubes and bolts and nuts. By this method of constructing girders the whole of the parts may be connected together by screw bolts and nuts, which is a great convenience in places where riveting cannot be conveniently effected. *Patent completed.*

3244 E. PERCE. *Improvements in geographical globes, and illustrative objects to be used therewith.* Dated December 30, 1864.

The object of this invention is to provide an available and convenient means for temporarily attaching objects to the surface of a geographical globe, and by this means to illustrate many of the natural laws and facts connected with the globe on which we live. The first part of the invention consists in making a geographical globe in whole or in part of a material capable of being permanently charged with magnetism, or of being attracted by a permanent magnet, whereby the patentee is enabled to temporarily attach to the said geographical globe objects illustrating the physical and geographical features of the earth. The second part of the invention consists in making objects illustrative of the geographical features of the earth, in whole or in part, or with attachments capable of being influenced by permanent magnetism, so that the same may be charged with such magnetism or attracted by a permanent magnet in the said geographical globe. The third part of the invention consists in the combination with a geographical globe made in whole or in pairs of a metallic substance capable of being attracted by or charged with permanent magnetism, of objects illustrative of the geographical or physical features of the earth, which are made of or with parts or attachments of like material, either the geographical globe or the objects being charged with permanent magnetism. *Patent completed.*

3245 A. S. MACRAE and A. BATLEY. *Improvements in the burners of hydrocarbon fluid lamps.* Dated December 30, 1864.

Attempts have been made to construct burners capable of being used without air distributors and chimneys or cones, and it is to this class, and to a simplification of the parts of the same, that these improvements have reference the object being to obtain a clear and strong light not readily to be extinguished by draughts or currents of air. The necks of the burners are provided with screws or their equivalents to fix into or to the fluid containers in any desired way, and rising upwards therefrom are ordinary wick tubes with wheels and thumb screws or other means for raising the wick. From the neck of each burner one, two, or more (the inventors prefer three) pillars or strips of metal or other material are carried upwards to support a dome or cupola, the top of which is immediately over the upper termination of the wick tube. The top of this dome or cupola has a slit across through its top, the ends of which are enlarged. Air is allowed to play freely around the wick tube, and to pass or rise upwards within the dome or cupola, and to come into contact with or impinge on the flame, so as to maintain proper combustion at and above the said mentioned slit or opening. *Patent abandoned.*

3246 A. O. ROBE. *Improvements in machinery or apparatus for brushing hair.* Dated December 30, 1864.

This invention consists of a metallic or wooden box or case, within which is set in suitable bearings an axle carrying a bevelled cogged wheel gearing with a mitre pinion, the shaft of which is extended to support a circular brush, the bristles of which project beyond the limit of the case; to the axle is attached a spiral spring, so that, when the axle is turned by a handle, the spring is wound up. A brake of a semicircular form is made to act on the shaft by means of a screw lever, so as to control or stop the unwinding of the spring, and a handle is placed at each end of the apparatus for the adjustment of the apparatus to the head. To relieve the weight india-rubber bands may be suspended from the ceiling, and the apparatus may be rested thereon. By the multiplying toothed wheels a great rapidity of rotation of the brush will be effected, the speed being regulated by the brake. *Patent abandoned.*

3247 E. COUPRANT. *A new rotative motive power.* Dated December 30, 1864.

In carrying out this invention the inventor proposes to erect standards on a bed plate or foundation, in order to support in bearings the axle of a driving wheel, on the circumference of which, at equi-distant points, four small grooved pulley wheels are set, the peripheries of which project beyond that of the driving wheel. The surface of the foundation of the machine is made of the form of an arc of a circle taken from the centre of the driving wheel, so as to leave room for the rotation of the four grooved pulleys. Between the pulleys and the foundation a flexible but non-elastic tube of fibrous or other suitable steam and watertight nature is placed, having flanged metal terminations at each end, and communications are established at each end with a steam boiler, and with an exhaust or condenser, so that by allowing steam to enter the tube at either end, its pressure will force open or fill the tube, and drive the grooved pulleys forward and round in regular succession, and thus carry the main wheel and axle with them, and by this means drive machinery or paddle-wheel propeller shafts by ordinary gearing used for such purposes. *Patent abandoned.*

3248 H. A. BONNEVILLE. *Machinery for manufacturing shoes for horses and other animals.* (A communication.) Dated December 30, 1864.

This invention cannot be described without reference to the drawings. *Patent completed.*

3249 H. A. BONNEVILLE. *Improvements in the construction of presses.* (A communication.) Dated December 30, 1864.

These improvements have for their object the reduction of the force necessary for working the presses intended for the compression of hay, cotton, fruit, and similar substances. The improvements consist in making the pressure in a horizontal direction by means of a vertical shaft worked by hand or other motive force, the upper end of which turns in a collar fixed in a frame, while the lower end pivots in a stop fixed in the same framework. *Patent abandoned.*

3250 T. BOUCH. *Improvements in the construction of roofs for sheds, railway stations, and similar structures.* Dated December 30, 1864.

This invention relates to certain improvements in the construction of roofs for sheds, railway stations, and other similar structures, the chief feature of which consists in the application of a compression bar upon the top side of the ridges forming the roof, and running transversely along them, the bar being fixed to the apices of the ridges by a saddle and bolts or cotters, or in any other way that may be found suitable. *Patent completed.*

3251 W. H. BROWN. *Improvements in the manufacture of cast steel and other metallic tubes.* Dated December 30, 1864.

This invention consists in an arrangement whereby the patentee is enabled to produce cast steel and other metallic tubes without a seam. In order to effect this, he employs a mandrel, upon which is placed a heated collar of the material of which the tube is to be formed. This collar is then submitted to the action of rollers which roll the metal out upon the mandrel and thus form the tube. The mandrel is formed with projecting parts, which determine the gauge of the tube, and the patentee fixes it during the operation of rolling by an abutment at one end, and by holding it at the other, or by both of those arrangements. He also proposes to support the said mandrel between the pairs of rollers, which supports may be removed as the tube advances. The rollers may consist of several pairs, and these pairs he disposes alternately with their axes at an angle to each other. *Patent completed.*

3252 L. P. E. MAX. *Improvements in treating oils and hydrocarbons, and in apparatus for the same and other operations in which matters have to be purified, clarified, refrigerated, or condensed.* (A communication.) Dated December 30, 1864.

The patentee claims, first, decolorising and disinfecting oils, by using sulphuric acid and soda in a hot state, substantially as described. Secondly, the process in which oil or other matter is passed through a series of vessels placed at different levels, in the manner and for the purpose described. Thirdly, the apparatus in which a series of vessels is placed, one below the other, as if on steps, and communicate by pipes in such manner that the oil or other matter to be treated may pass from one vessel to the next, and rise through the contents thereof, as described. Fourthly, the mode of condensation or refrigeration by a number of consecutive chambers containing concentric pipes, as described. Fifthly, the refrigerating or condensing apparatus in which a series of chambers containing concentric pipes is arranged and combined, as described. *Patent completed.*

3253 J. LADLEY. *Improvements in carding engines.* Dated December 31, 1864.

This invention relates to that kind of carding engine known as a condenser, the object being to obviate or prevent unevenness in the cardings or silvers produced when carding wool or other fibrous substances, or to obtain silvers or condenser threads of equal weight from each or all parts of the doffer or delivering end of the machine, whether such unevenness may arise from irregularities of feeding, blasts, draughts, or other causes. To attain this object the patentee traverses the "angle stripper," or produces reciprocating motion thereof, in combination with the usual rotary motion, and in such manner as to be continually changing with regularity the points of contact between the "breast," the said "angle stripper," and the swift, so that lateral action is effected on the fibre in transferring it from one cylinder to another. This reciprocating motion he prefers to produce by means of an endless spirally grooved boss, mounted loosely on the stripper shaft, so as to rotate freely, but not slide endwise thereon. This boss may be driven by pulley and cord or strap at any suitable speed from a pulley applied to any convenient moving part of the engine; and by having a pin or finger fixed to the framing entering the groove, the required motion is produced, according to the peculiar form which may be given to the said groove. *Patent completed.*

3254 W. E. NEWTON. *Improved machinery for making horsehoes.* (A communication.) Dated December 31, 1864.

For the purposes of this invention the bar iron of which the horse shoes are to be made is to be cut up in pieces of suitable length, and these pieces when heated (so that they may be more easily bent) are placed in the machine against a fixed die or mould, around which they are bent by means of movable jaws. The heated pieces of iron are then submitted to pressure between dies, which are moved up and down by means of cranks, or by a piston fitted in a steam or air cylinder. *Patent completed.*

3255 P. A. ROGER. *Improvements in smoke-consuming furnaces.* Dated December 31, 1864.

This invention relates to steam boiler distilling, vaporising, and similar furnaces generally, and also to furnaces for the desulphuration of ores. They consist in an apparatus for distributing the fuel so as to deprive it of its gases and smoke before throwing it on the grate. This distributing apparatus is fed by a funnel placed outside. It is composed of a trough wheel (roue à auge) having five or seven compartments formed by a similar number of partitions placed tangentially to a central strap, which compartments or troughs receive consecutively the fuel falling from the aforesaid funnel. The trough wheel is turned by hand, or any suitable mechanical means. The said trough wheel is placed in the upper and front part of the furnace, so that the fuel contained in its compartments is submitted to the heat of the furnace, by which it is converted into coke or carbonised before being thrown on the firegrate. The gases and smoke being obliged to pass through the flames of the burning combustible are burnt before leaving the flue. In order to insure a more perfect combustion of the fuel by stirring or poking, one or more shafts may be placed in a transverse direction to and under the bars of the grate, on which shafts are fixed wings placed at such distances as to pass between all the bars at each entire rotation. These automatic fuel stirrers may be moved by hand or any suitable mechanical contrivance connected with or independent of that which actuates the distributing trough wheel. In furnaces where the object is to desulphurise ores by the introduction of a mixture of air and steam, an apparatus consisting of two concentric cones between which the air passes may be employed. At the centre of the apparatus is placed a tube provided with a cock serving for the entrance of steam derived from the escapement of the engine, or generated by a water jacket surrounding the furnace door. The mixture of steam and air passes under

the grate. The concentric cones are cast together in one piece, and are fixed in the brickwork of the furnace in such manner as to project the mixture of steam and air under the grate. *Patent completed.*

3256 T. RICHARDSON. *Improvements in the manufacture of manure.* Dated December 31, 1864.

The object of this invention is to obtain by means of levigation phosphate of lime in a finely divided state from such sources as bone, ashes, animal charcoal, coprolites, apatite, or mineral phosphate, and also to reduce and obtain such guanos as Kooria, Moorla, Sombrero, or Navassa, to or in a state of the finest possible division by means of levigation. *Patent completed.*

3257 F. J. ENDRES. *A new musical apparatus, printing on paper the music while being executed on pianos, organs, or other key instruments.* Dated December 31, 1864.

Provisional protection has not been allowed for this invention.

3258 R. QUIN. *Improvements in the manufacture of cases for jewellery, for optical and other instruments, and for miniatures and other articles.* Dated December 31, 1864.

This invention relates to a former patent dated 3rd May, 1853 (No. 1,076). The patentee proposes, under one modification of the invention, to make the rims in the following manner:—A metal mould of the shape required for the rim is fitted to the hollow mould already made for the top, which may be either fixed to or be in a separate piece from it, which latter is found more convenient; the thin wood or scaleboard is then wound round the inside of the metal rim mould, and the paper which is to form the top is worked into its place at the same time; the inner or convex mould is then placed inside; the edges of this mould are made to correspond to the shape of the rim mould, room being, however, allowed between them for the thicknesses of the rim of scaleboard; the whole is then pressed, and when sufficiently dry can be taken out of its mould, the rim and top being perfectly formed in the one process. *Patent completed.*

3259 T. DU BOULAY. *Improvements in carriages propelled by manual power.* Dated December 31, 1864.

For the purposes of this invention a carriage is constructed to move on a pair of hinder-wheels and a pair of fore-wheels. The fore-wheels and axle have a locking motion in the ordinary manner for facilitating the guiding of the carriage. On the axle of the hinder pair of wheels, and about midway between the pair of wheels, is a pinion. The person that is in the carriage sits on a seat over the hinder axle, and by his hands gives a to-and-fro motion to a handle or handles in front of him. The handle is connected to a pair of toothed racks between which the pinion on the hinder axle is situated. The racks are formed together into a frame which slides to-and-fro. The two racks are at such a distance apart that, when the teeth of one rack is in gear with the teeth of the pinion, the teeth of the other rack are out of gear with the teeth of the pinion; hence, when the handle is moved to and fro, the racks are moved to and fro also, and by being caused to rise and fall at the end of each stroke, the teeth of the two racks alternately gear with the pinion and cause it to rotate continually in one direction. The feet press against the forward axle, or against projections thereon, by which the fore part of the carriage acts as a stretcher in a boat, and the carriage is guided by the feet acting to cause the fore axle to perform its locking action. *Patent completed.*

3260 C. W. SIEMENS. *Improvements in the means and apparatus for obtaining and applying motive power.* (Partly a communication.) Dated December 31, 1864.

This invention is based upon the physical property of some liquids, such as paraffine, to expand very considerably on being heated. For the purposes of the invention a closed receptacle that is capable of resisting considerable internal pressure is filled with such liquid. One extremity of this receptacle (which may conveniently be of a cylindrical form) is exposed to a source of heat, whereas the other extremity is cooled by the external application of cold water, or by the charging at a suitable moment a portion of the liquid contained in the receptacle, or otherwise. A plunger or piston is provided, which, in being moved to and fro within the cylindrical vessel, transfers the liquid (or a considerable portion of the same) alternately from the heated portion of the vessel to the cooled portion, and vice versa. A regenerator or cavity filled with divided surfaces of metal or other refractory materials is interposed, through which the liquid passes to and fro, and which serves to retain the greater portion of the heat contained in the liquid, when this liquid is forced from the heated to the cooled portion of the vessel, and to restore the same to the liquid on its return. *Patent abandoned.*

1 W. MUIR. *Improvements in the construction of public houses and other houses of entertainment.* Dated January 2, 1865.

This invention consists in constructing the whole of the front of public-houses, and other houses of entertainment (where men and women mix indiscriminately together) of plate glass, to enable persons outside to see those within. Ingress and egress passages of about 2 ft. wide are provided to admit customers, but to impede and prevent as far as is possible the entrance of females wearing steel corsets. A space is left between the front of the house of entertainment and the footpath of not less than 3 ft. wide, under which passes a heated flue; this space is intended to afford shelter and warmth to destitute poor during the night. When the house is closed at night, and on Sundays, a public fountain provided with a filter supplied with water from the house is turned on for the benefit of the public. *Patent completed.*

2 T. A. MACAULAY. *Improvements in sewing machines and apparatus belonging thereto.* Dated January 2, 1865.

This invention consists, firstly, in the adaptation to sewing machines of a novel mechanical arrangement for driving the vertical or sewing needle and the shuttle, the object being to produce from a regular rotation of a shaft an irregular reciprocating motion specially suited to the needles of the vertical needle and the shuttle. Secondly, in an improvement in the construction of the framework which facilitates the obtaining of perfect parallelism in the horizontal shafts above and below the table. And, lastly, in a novel construction of thread controller. The invention cannot be described without reference to the drawings. *Patent completed.*

3 M. R. LIVERSON. *An improved method of treating apatite and other mineral phosphates.* (A communication.) Dated January 2, 1865.

This invention consists in the separation of impurities more or less perfectly by mechanical means and pro-

cesses. With this object these highly impure ores containing phosphates are crushed or ground, by which the crystallised phosphates and the impurities will be broken apart, and the constituents of the masses will be disintegrated, so as to admit of the impurities being removed from the crystallised phosphates by means of hand picking, washing, and jugging. The phosphates may then be more readily acted on by the proper acid. *Patent completed.*

4 E. BRYAN AND A. FLEMING. *An improved jacket or protector for metallic and other vessels and structures containing solid substances, liquids or gases, to prevent radiation of heat from or communication of heat to such vessels and structures.* Dated January 2, 1865.

This invention consists in jacketing or protecting vessels and structures either wholly or partially, as may be necessary, by atmospheric air or other gaseous fluids, preferably not in communication with the external air. To keep the inner and outer vessels and the structure and casing apart, small pieces of earthenware or other non-conductor of heat are used. Where the temperatures are high and fluctuating, one or more small openings; the air might be left in the outer vessel or casing, and such openings could be provided with safety valves to open outwards and inwards, so as to allow for increase or decrease of pressure of the said jacket or protector of atmospheric air or other gaseous fluids. *Patent completed.*

5 J. F. PARKER AND J. TANNER. *Improvements in the manufacture of oxygen gas, and in treating and economising the residual products of the said manufacture.* Dated January 2, 1865.

The patentee claims manufacturing oxygen gas by heating a mixture of nitrate of soda and quick lime. Also, obtaining from the said products caustic soda, and a compost consisting of lime and nitrate of lime. *Patent completed.*

6 J. SMITH, jun., and J. WILLIAMSON. *An improved method of and apparatus for lubricating the axles or journals of coal or ironstone waggons or tubs, or of other carriages or rolleys used upon tramways or railways for carrying mineral or other material.* Dated January 2, 1865.

The patentee claims the lubrication of such axles or journals whilst in motion, by means of revolving wheels dipping into a reservoir of oil or lubricating material, such wheels being so mounted that the axles or journals to be greased shall roll over the surface or periphery of the lubricating wheels, and thus become lubricated. *Patent completed.*

7 J. SPENCER AND N. BROOMHEAD. *The application and use of certain materials to be employed in the manufacture of carpets and hearthrugs.* Dated January 2, 1865.

This invention relates to the manufacture of carpets and hearth rugs from remnants of winey, linsey, oleum, alpaca, flannel, woollen cloth, moreens, and stuff goods. These are cut into strips of suitable width, and their ends secured together by stitching or sewing, so as to obtain any desirable length. This the patentee uses as the warp used is of cotton, hemp, or jute band, and may be dyed to any colour. *Patent completed.*

8 J. R. CROMPTON. *Improvements in machinery for smoothing or finishing paper.* Dated January 2, 1865.

One of these improvements has for its object the prevention of the breakage of the paper, and consists in driving the second set of rollers or second calendar by a separate steam engine, turbine, or water wheel, by which means the paper passing from one calendar to the other may be kept at any desired tension by the power allowed to be exerted by the steam engine, turbine, or water wheel; and if the motive power be less than that required to turn the calendar and overcome the tensile strength of the paper, breakage will be avoided. The inventor places separate levers to act on each end of all the rollers in the calendar except the bottom one, in such a manner as to lift them a sufficient distance to allow the creased paper, if any, a free passage between the said rollers, without damaging them, and when the paper is passing evenly between all the rollers they are again lowered, and the process of smoothing or calendaring goes on without damaging the rollers by the action of creased paper. *Patent abandoned.*

10 F. GYE. *Improvements in mounting photographic, printed, and other pictures.* (A communication.) Dated January 2, 1865.

This invention has for its object the so mounting photographic printed and other pictures that peculiar effects are produced by reason of two pictures, in each case being combined with and superimposed one on the other on a sheet of glass. *Patent abandoned.*

11 M. BENSON. *An improvement in ordinary lift and force pumps.* Dated January 3, 1865.

The nature of these improvements consists in so constructing the pump that the cylinder or barrel of it can be turned and secured to any joint within the range of its motion for bringing the discharge spout to any desired position; also in arranging the handle or lever for working the piston so that it can be moved around the circumference of the cylinder secured and worked from any point to suit the position of the pump. By thus making the two parts movable, as described, the pumps can be placed in the least possible cramped space, and any position without having to be specially constructed for the purpose. The lower and upper end of the cylinder of the pump is made without flanges, in place of which they are furnished with dovetailed-shaped forms. A recess flange or plate is used for attaching to the lower end of the cylinder, for the double purpose of serving as a valve seat for the inlet valve and securing the pump to its place for working. The end of the cylinder is placed into the recessed flange, and by means of one bolt and nut the cylinder of the pump can be secured to the flange sufficiently tight to make a joint between the end of the cylinder and flange. This joint is made by letting a portion of the valve leather extend between the end of the cylinder and surface of the flange. The nut of the bolt, which bolt comes up through the recessed flange, for holding the cylinder to the flange, is made conical and passes against the side of the cylinder at an angle, and thereby forces the end of the cylinder against the flange. Two or more projecting lugs are cast around the recess in the flange, against which lugs the dovetailed sides at the end of the cylinder are forced by the angular or lateral pressure of the conical nut. The lugs are so shaped that they direct the end of the cylinder of the pump against the plate when the pressure is applied by screwing the conical nut, and thereby forms an evenly tight joint between the whole surface of the cylinder end and flange. By loosening the conical nut the cylinder can be placed or turned to any position for placing the discharge spout where desired, and the cylinder valves and working parts can be entirely re-

moved by taking off the nut. The cover or flange for the top of the pump is similarly constructed and attached by means of one bolt and nut. The lever is joined to the cover of the pump and consequently can be turned around and held to any point within the range of its motion. For the smaller class of pumps one bolt and nut will be sufficient to hold the upper and lower flanges to the cylinder, but for the larger class of pumps it will be preferable to use two or more bolts and nuts. *Patent completed.*

12 W. G. HELSBY. *Improvements in the manufacture of enamelled glass to render it more useful in photographic art.* Dated January 3, 1865.

In carrying out this invention, the opal or other coloured enamel and the glass are united together in the process of manufacture in the usual way, but, instead of the glass to or with which the enamel is secured or made being transparent and colourless, the inventor makes it with a "body colour" of any desired tint or quality by placing the proper materials in the glass pot. Rose and cream will be the most desirable colours when the enamel is opal, but the colours may be varied. When the enamelled surfaces are polished, the sheets are ready for use. *Patent abandoned.*

13 G. MURCART. *Improvements in sewing machines.* Dated January 3, 1865.

This improved sewing machine, which is intended to serve as a plaything for children, is made entirely of metal, and consists of a small figure lying on its back; the legs being hollow and thrown over the head admit of a small shaft running through them, one end of which is fixed to the centre of a small band wheel, and the other, which communicates motion to the needle, turns in a metal box fitted to the feet of the figure; to this end of the shaft is attached a piece of metal of unequal proportions, the object of which will be mentioned hereafter. At the bottom or bed of the apparatus, which is hollow, and may be made of any form and dimensions, is another shaft supported and turning in bearings fixed in any convenient position in the bed of the machine for that purpose; round this shaft is passed a spiral spring, one end of which shaft is bent for about the length of an inch in a perpendicular manner, the remainder being curved, the extreme end being furnished with a roller running on slides fixed on the hand wheel, and curved in such a manner as to communicate to the shaft a backward and forward movement, which is facilitated by the spiral spring. At the opposite end of the above mentioned shaft a small hook is fixed and placed directly under the needle, so as to catch the thread and form a loop as soon as the needle has penetrated the material. The reel of thread or cotton turns on a pin placed in any convenient position on the figure, and is prevented from jumping or rising while revolving by means of a small spiral spring placed over the pin above the reel, and passing gently on the reel by means of a screw head fitting on the pin. *Patent abandoned.*

14 H. LLOYD. *Improvements in perambulators, a part or parts of which improvements may also be applied to other wheel carriages.* Dated January 3, 1865.

This invention consists, firstly, in making the handle situated at the back of the perambulator, and by which it is propelled, capable of turning down, instead of making it fixed, as heretofore. By making the handle capable of turning down, it may be folded against the body of the perambulator when it is not in use, and the perambulator thereby made to occupy less room. The invention consists, secondly, in improvements in connecting the wheels of perambulators to their axles. This part of the invention has for its object the effectual securing of the wheels to their axles, and facilitating their removal when it is required to remove them for packing, or for any other purpose. The invention cannot be fully described without reference to the drawings. *Patent completed.*

15 L. D'AUVERVILLE. *Improvements in manufacturing paper.* (A communication.) Dated January 3, 1865.

This invention relates to the mode of drying up the endless sheet of paper as it runs out of the pulp machine. The process consists in using a hot room or chamber into which the endless web or sheet of paper is introduced, and carried along by a special endless chain which travels a distance of many yards within the said room or chamber. The hot room or chamber is heated by hot air drawn out by a fan from the furnace used for generating steam employed in the other departments of the manufacture, the hot air being forced by the fan into the hot room or chamber; the fire of the furnace must be made with coke, and not with any kind of fuel producing smoke. The sheet or web of paper perfectly dried up is then led out of the hot room through a suitable aperture, and is coiled around a cylinder suitably disposed to receive it. *Patent completed.*

16 T. J. ASHTON. *An improved portable pneumatic apparatus, applicable in surgery and medicine for all purposes as a douche for effusion, irrigation, injection, and for emesis.* Dated January 3, 1865.

This improved pneumatic apparatus is applicable for administering douches or injections for all sanguinal or medicinal purposes, and the principal object of the invention is to construct a portable and effective apparatus, and, at the same time, to prevent the injection of any air with the water or other liquid composing the douche or injection. The apparatus is composed principally of two vessels—one contained within the other—each vessel being made of an impermeable material, the inner one being flexible and compressible, india-rubber by preference, and the outer one inelastic, being either made of a rigid material, or of a compressible substance, such as canvas, or other textile material, lined with india-rubber, as may be preferred. Each of these vessels is furnished with a tube provided with a stop-cock, but there is no communication whatever between the two vessels. A small detachable or fixed syringe or air pump for charging the outer vessel with compressed air is also provided. The action of the apparatus is as follows: The inner vessel is to be filled with the water or other liquid composing the douche or injection, by means of a funnel or otherwise, and the latter being removed its stop-cock is closed. Air is then compressed into the outer vessel by means of the syringe or air-pump until a sufficient pressure is obtained according to the force desired. Upon closing the stop-cock of the outer vessel, and removing the syringe, if desirable the apparatus is now ready for use, and upon the stop-cock of the inner vessel being opened, the expansion of the compressed air in the outer vessel will compress the inner vessel and force out the water or liquid which it contains, the force of the steam depending upon the amount of air that had been previously compressed into the outer vessel. If a more continuous and undiminished force is desired than can be obtained by these means, the stop-cock of the

outer vessel may remain open, and the syringe be kept at work during the operation. *Patent completed.*

17 L. GOLDBERG. *An improved belt.* Dated January 3, 1865.

This belt consists of a number of metal plates, tablets, or hollow slabs of any desired shape connected or strung together by cords or bands of elastic material passed through the edges of the plates, tablets, or slabs, which edges are bent inward or at right angles, or nearly so, to the main plane of the plate, slab, or tablet. The belt so constructed is very elastic, flexible, and light, but, at the same time, strong and substantial. Two lengths of elastic are sufficient, one passing through the upper and the other through the lower part of the plates. The plates may be close together, or balls or other ornaments may be strung on the elastics between the plates. The belt may terminate at the ends in ordinary fastening arrangements. The outer surface may be plain or ornamental, and gilt or otherwise. *Patent completed.*

18 G. HODGSON and J. PITT. *Improvements in drilling apparatus for hand or steam power, adaptable also as a vice and for lifting purposes.* Dated January 3, 1865.

This invention cannot be described without reference to the drawings. *Patent completed.*

19 E. KIRBY. *Improvements in the manufacture of elastic packings for pistons.* Dated January 4, 1865.

This invention consists in manufacturing elastic packing for the pistons and piston-rods of steam-engines or pumps in the form of a flat rope or web composed of two or more strands or plaits of hemp, or other fibrous substances, united together in a loom or other suitable machine by a binding web, as shown in the drawings. Another part of the invention consists in combining with the tallow and oil or other ingredients employed to lubricate the packings of pistons, a certain proportion of soda ash, to allow the steam to penetrate the packing, and thus to prevent it being burnt. *Patent completed.*

20 W. PATTON. *Improvements in the means or apparatus for measuring water or other liquids.* Dated January 4, 1865.

By the apparatus constructed according to these improvements the inlet and the outlet passages are each formed double, so as to be closed by a pair of valves, the pressure of the liquid on which is rendered neutral, or nearly so. The chamber into which the water or other liquid passes to be measured is provided with a movable cover, acting as a float or piston, which rises with the flowing into this chamber of the liquid to be measured, and the upper part of this chamber above the float opens into another chamber which acts as an air chamber, and by its having communication with the passage for the measured liquid it also acts as a reservoir of the measured liquid. The water or other liquid to be measured passes into the measuring chamber by one pair of the equilibrium valves, whilst the outlet passages from the measuring chamber are closed, and the flowing of the liquid into the measuring chamber causes the float to rise to a point capable of being varied or regulated when it acts to alter the position of a balance weight, causing that weight to change the position of the two pairs of valves by closing the inlet valves and opening the outlet valves, when the liquid in the measuring chamber will pass away therefrom until the float in its descent again acts upon the balance weight to cause it to reverse the position of the inlet and outlet valves, when the outlet valves will be again closed and the inlet valves opened, as before, and so on. A passage capable of being closed is provided for supplying air when desired to the reservoir chamber. The inventor also, in some cases, applies an air vessel to the inlet pipe to check the effect of momentum of the liquid at the change of position of the valves. *Patent abandoned.*

21 J. KNOWLES and J. BANKS. *Certain improvements in mules for spinning.* Dated January 4, 1865.

This invention relates to that portion of mechanism employed in hand or self-acting mules by which the "run in" and out of the spindle carriage is effected, and is designed to keep the yarn whilst being spun even and regular, and also to impart greater strength when the spindle carriage is completing its "run out." The improvements consist in imparting to the spindle carriage of mules a differential or varying speed when running out, which commences quickly and gradually diminishes in speed as the distance of the spindles from the front rollers increases. The effect may be produced by several mechanical arrangements, the method which the patentees prefer being herein described. Upon the ordinary cam or worm shaft of the mule, or in any other convenient position, about the head stock, one or more cones are arranged, which, when caused to revolve, transmit through the medium of suitable bevel and "jack-in-the-box" gearing a differential motion to the long driver shaft of the mule which moves the carriage, and also through such shaft motion is imparted to the rollers for delivering the yarn by means of bevel wheels, so as to suit the differential or varying motions of the spindle carriage when running out. A second arrangement of apparatus for effecting the differential or varying motion of the carriage may be obtained by driving the long driver shaft from the worm shaft of the mule by the means of bevel wheels of different diameters, which are connected to and drive the arrangement of the "jack-in-the-box" which gives motion to the long driver shaft, that is to say, the wheels giving motion to the "jack-in-the-box" when the carriage commences its "running out" are of small diameter and quick speed, giving the carriage a quick run until half its distance is accomplished, at which time motion is given to the jack and long driver from the worm shaft through wheels of a greater diameter; consequently, the speed of the carriage becomes diminished during the remainder of its run out, as required. The differential motion can also be effected without the arrangement of jack-in-the-box to suit particular work, in which case one or more cones are driven in connection with the long driver and front spindles, thereby giving the required twist to the yarn. *Patent completed.*

22 W. CLARK. *Improvements in electro magnets and their application in telegraphic and other purposes.* (A communication.) Dated January 4, 1865.

This invention consists, first, in constructing electro-magnets, galvanic battery frames, and other electro-magnetic apparatus based upon the employment of circuits of uncovered metal wire, by which is understood a wire uncoated with any insulating substance, such as cotton, silk, gutta serena, gumlac, or any suitable varnish. Second, in the application of these improvements to all kinds of electro-magnetic apparatus used in telegraphy and otherwise. *Patent abandoned.*

23 W. AOKA. *Improvements in fan blowers.* Dated January 4, 1865.

This invention relates to a peculiar construction of fan whereby a greater power of blast is obtained than by the fans hitherto in use. According to one modification of this invention the blades of the fan are carried by a disc wheel, which is keyed or otherwise secured to the fan spindle. Each fan blade is curved outwards and backward as regards the direction of revolution, and is throughout its entire length of a V form in transverse section, the hollow or trough being on the front side of the blade. The disc wheel is situated in the centre of each blade, so as to intersect it longitudinally, one half or side of the blade being on each side or face of the disc. One end of these blades extends nearly to the centre of the disc, whilst the outer end projects some little distance beyond the periphery of the disc. The trough or channel of each blade is both broader and deeper at the inner end than at the outer extremity, and it is preferred to remove or bevel off the corner on each side of the trough or V at its outer end. According to another modification the disc wheel may be dispensed with, and the curved V-shaped blades may be each carried by a separate arm on a boss fast on the spindle of the fan. In both arrangements the patentee prefers to enclose the revolving blades between a pair of discs which are secured to the sides or lateral edges of the blades, and are open in the centre and converge towards each other at their peripheries, these discs forming in fact a portion of the revolving part of the fan. The whole is enclosed in an ordinary fan casing shaped to conform to the taper of the blades. *Patent completed.*

24 D. VERRICCHIO. *Improvements in the construction of spring mattresses and palliasses.* Dated January 4, 1865.

In performing this invention the patentee proposes to construct two frames of iron bars or mouldings of any suitable dimensions and form required, and to attach thereto, lengthwise, and across flat, bands of iron or steel, to form a bearing surface. These two frames are placed one over the other, the flanges being turned to each other so as to form ledges, and underneath and between each intersection of the iron bands, or some of them, a helico-spiral or other spring is fixed. Each end of the frame has in all large sizes one carriage spring, or any other shape of spring, flat or otherwise, fixed between the iron frames, and each side of the frame has two or more similar springs to support the upper frame on the under one. *Patent completed.*

25 J. F. JONES. *Improvements in machines for making paper board.* Dated January 4, 1865.

We cannot here give space to the details of this invention. *Patent abandoned.*

PROVISIONAL PROTECTIONS.

Dated March 8, 1865.

642 F. Tolhausen, Boulevard Magenta, Paris. Improvements in breech-loading fire-arms. (A communication.)

Dated April 8, 1865.

967 J. I. Darriest, Dax, France. Improvements in the seats of waterclosets.

Dated April 24, 1865.

1141 W. E. Gedge, Wellington-street, Strand. An improved passary. (A communication.)

Dated May 3, 1865.

1232 J. B. Lavanchy, Peter-street, Wardour-street, mechanic. A new or improved chair ladder.

1238 T. W. Roe, Arkwright-street, Nottingham. Improvements in machinery for folding and carding lace or light fabrics.

Dated May 29, 1865.

1468 H. Mowley, Olveston, Gloucestershire, clerk. A new or improved machine for obtaining motive power, and other useful purposes.

Dated May 31, 1865.

1496 W. A. Brown, Carlisle-street, Newcastle-on-Tyne. Improved mechanical arrangements for steering ships and other navigable vessels.

Dated June 15, 1865.

1620 E. A. Brooman, Fleet-street, patent agent. Improvements in furnaces. (A communication.)

Dated June 16, 1865.

1628 M. Henry, Fleet-street. Improvements in the method of and apparatus for effecting and recording telegraphic communications. (A communication.)

1632 C. A. Lamont, New York. An improved mode of desiccating eggs, and apparatus for effecting the same.

Dated June 19, 1865.

1644 E. Whalley, Blackburn, Lancashire, cotton spinner. Improvements in machinery for twisting, doubling, and laying all kinds of yarns.

1646 G. Smith, jun., Richmond-terrace, Clapham-road, civil engineer. Improvements in locomotive engines and railway carriages.

Dated June 20, 1865.

1655 E. G. Brewer, Chancery-lane. Improvements in the construction of taps or valves. (A communication.)

1656 W. Clark, Chancery-lane, engineer. Improvements in the means and apparatus for generating motive power. (A communication.)

Dated June 21, 1865.

1665 W. Clark, Chancery-lane, engineer. Improvements in apparatus for typographic and lithographic printing. (A communication.)

Dated June 22, 1865.

1672 S. Godfrey, Middlesborough-on-Tees, Yorkshire, engineer. Improvements applicable to furnace bars and fire-grates.

1673 N. de Becker, Gloucester-road, Hereford-square, Old Brompton. Improvements in umbrellas and parasols.

1674 E. K. Dutton, Sale, Cheshire, merchant. Certain improvements in apparatus for measuring and indicating the flow of liquids.

1675 J. M. Abrams, Moorgate-street, merchant. Improvements in apparatus for the reception of coin.

1676 M. Siegrist, Montpellier-road, Brompton. Improvements in apparatus for the use of passengers and others for signalling in railway trains.

1677 W. E. Newton, Chancery-lane, civil engineer. Improvements in surface condensers. (A communication.)

1679 J. Gale, jun., Devonshire-terrace, electrician. Improvements in preparing and treating gunpowder.

Dated June 23, 1865.

1680 A. E. Dobbs, B.A., Lincoln's-inn, barrister-at-law. Improvements in drags for carriages.

1683 L. White, Paisley. Improvements in clay tobacco pipes.

1684 W. J. Murphy, Lady's Well Brewery, Cork. An improved apparatus for stopping railway trains.

1685 W. Lusty, Birmingham, machinist. Improvements in machinery for the manufacture of needles.

1686 E. Finch, Chesham, Monmouthshire. Improvements in machinery and apparatus for the manufacture of rivets, bolts, spikes, and similar articles.

1687 H. B. Snell, Chancery-lane, and F. E. Thomas, Manchester-terrace, Liverpool-road, Islington. Improvements in apparatus used in supplying gas to burners.

Dated June 24, 1865.

1688 H. A. Bonneville, Porchester-terrace, Bayswater. Improvements in lifeboats. (A communication.)

1689 R. Eastman, Islington. Improvements in eastons.

1690 M. A. Muir and J. M'Ilwham, Glasgow, machinists. Improved sanitary apparatus or arrangements for preventing noxious exhalations such as arise when coating or treating iron or other articles.

1691 R. A. Brooman, Fleet-street, patent agent. An improved portable table or seat. (A communication.)

1692 J. Solomon, Red Lion-square, optician. Improvements in the preparation of magnesium for illuminating purposes. (A communication.)

1693 O. R. Bamber, Jersey, Com. R.N. A new or improved apparatus for producing the magnesium light.

Dated June 26, 1865.

1694 T. L. Jowett, Swansea, Glamorganshire, architect. Improvements in bricks.

1700 M. Ashby, Staines, brewer. An improved brewer's and distiller's refrigerator or apparatus for cooling liquids, condensing steam or other vapours.

1701 J. K. Spanoghe, Rue de l'Equerre, Antwerp. An improved hydraulic apparatus for producing motive power.

1702 R. A. Brooman, Fleet-street, patent agent. Improvements in machinery for printing in colours. (A communication.)

1704 S. B. Bateson, Bolton-street, Mayfair. Improvements in croquet mallets.

1705 J. Whittle, Frampton-terrace, Boston, Lincolnshire. Improvements in forming the permanent way of railways.

1706 J. Medhurst, Rotherhithe-street, Surrey. Improvements in portable punching apparatus.

1707 W. E. Newton, Chancery-lane, civil engineer. Improvements in the manufacture of hats and other felt goods and fabrics. (A communication.)

1708 W. E. Newton, Chancery-lane, civil engineer. An improvement in pianofortes. (A communication.)

Dated June 27, 1865.

1709 H. M. Kennard, Viaduct Works, Crumlin, near Newport. Improvements in machinery for riveting and for making rivets.

1711 R. A. Brooman, Fleet-street, patent agent. An improved method of and apparatus for burning liquid hydrocarbons, and the employment thereof for heating purposes. (A communication.)

1712 J. Spratt, Stranraer-place, Malda Vale. Improvements in apparatus for cutting, hay, straw, and other vegetable materials.

1713 J. Kirkham, Manchester, timber merchant. Improvements in securing the rails of railways.

1714 J. H. Johnson, Lincoln's-inn-fields. Improvements in cotton gins. (A communication.)

1715 W. Brooks, Philadelphia-street, Bristol. Improvements in heating, chisels, knives, plane irons, gouges, augers, steels, shears, scythes, and saws.

Dated June 28, 1865.

1717 W. Ingham, Manchester. Improvements in circular pressing machines for finishing woven fabrics.

1718 J. K. Farnworth, Alderley Edge, Cheshire. Improvements in or applicable to railway and other carriage windows.

1719 W. E. Newton, Chancery-lane, civil engineer. Improvements in the preparation of amalgams of quicksilver or mercury, and in the application of such amalgams to various purposes in the arts. (A communication.)

1721 J. Webster, Glasgow, shirt maker and clothier. Improvements in under vests.

1722 W. Percival, Aston-by-Budworth, Cheshire, farmer. A new or improved table or support to be employed in the dressing and finishing of cheeses.

1723 R. Boot, Arboretum-street, lace designer, and J. Coxon, Long Hedge-lane, New Sneyton, Nottingham, draftsman. Improvements in twist lace machines.

1726 W. E. Newton, Chancery-lane, civil engineer. An improved shirt front. (A communication.)

1728 E. Reynolds, Albert-road, Nunhead, schoolmaster. Improvements in apparatus for preventing the opening of sash windows from the outside, and for the secure fastening thereof.

1727 W. Botham, Sheffield, pharmaceutical chemist. A new and improved food or fluid regulator for feeding bottle and other tubes.

Dated June 29, 1865.

1729 D. T. J., and J. Mercer, Great Harwood, near Ayrington, Lancashire, manufacturers. Improvements in sizing machines for sizing yarns, beams, or warps to be woven.

1731 J. Cox, Georgie Mills, Edinburgh, glue maker. Improvements in oars, paddles, rowlocks, seats and fittings for boats and vessels.

1733 A. Prince, Trafalgar-square. A new or improved self-acting apparatus for distributing the feeding materials in high furnaces. (A communication.)

1735 W. E. Newton, Chancery-lane, civil engineer. Improvements in locks. (A communication.)

Dated June 30, 1865.

1737 W. Schofield, Heywood, Lancashire, manager. Improvements in the manufacture of gas retorts and other articles made of fireclay, and in furnaces for burning the same, and for other purposes.

1741 R. A. Brooman, Fleet-street, patent agent. Improvements in the manufacture of collars and cuffs. (A communication.)

1743 J. Keighley, Bradford, power loom manufacturer. Improvements in looms for weaving.

1745 E. Elliott, Wharf-road, City-road. Improvements in steam boilers, furnaces, and engines, and in parts connected therewith.

Dated July 1, 1865.

1747 G. Davies, Serle street, Lincoln's-inn, civil engineer. Improvements in knitting machines. (A communication.)

1749 J. Atkins, Birmingham, merchant and manufacturer. Improvements in the manufacture of certain kinds of metallic tubes and rods, and in ornamenting metallic tubes and rods.

1751 W. M'Gregor, civil engineer, Kidbrooke-villas, Blackheath. Improvements in the points and crossings of railways.

Dated July 3, 1865.

1753 I. Bagge, Chancery-lane, electrical engineer. Improvements in submarine telegraphy, which improvements are also applicable in some cases to land telegraphy.

1755 E. Deane, City, engineer. Improvements in tubular structures, rendering them specially applicable for ships' masts and building purposes.

1757 S. Bates, New Radford, Nottingham, lace manufacturer. Improvements in the manufacture or production of bobbin net or twist lace made on bobbin net or twist machines.

1759 J. Naveaux, Streppe Braquegnies, Belgium, merchant. Improvements in apparatus for stopping and retarding railway carriages and locomotive engines.

1761 L. H. G. Ehrhardt, Aldridge-road-villas, Bayswater. Improvements in vices.

Dated July 4, 1865.

1763 P. Passavant, Bradford, commission merchant. Improved linings for ladies' dresses. (A communication.)

1767 J. Harrington, Lansdowne-terrace, Acre-lane, Brixton. Improvements in carriages.

1769 J. E. Wilson, Gramere, Torquay, Devonshire, civil engineer. Improvements in locomotive engines, and in springs of railway carriages.

Dated July 5, 1865.

1771 W. E. Gedge, Wellington-street, Strand. An improved circular endless railway. (A communication.)

1777 J. W. Gray, St. Durstan's-hill, City. Improvements in machinery for cleaning and deoiling rice and other grains and seeds.

1779 H. Emanuel, New Bond-street, court jeweller. A new manufacture of or improvement in ornaments for personal wear.

PATENTS APPLIED FOR WITH COMPLETE SPECIFICATIONS.

Dated July 11, 1865.

1834 N. Jenkins, Boston, U.S. Improvements in steam and water valves.

LIST OF SEALED PATENTS.

Sealed July 14, 1865.

147 W. Jeffreys	154 J. Coulter and H. Harpin
149 E. Deane	161 E. D. Faroot
150 S. Ballard	166 W. O. Hicks
151 J. W. Gregg	169 M. Robinson
153 J. Burch	224 R. Mushet
159 A. W. Proger	

Sealed July 18, 1865.

170 D. Munro and T. Wright	281 J. M'Naught and W. M'Naught, jun.
172 J. Turney, jun., and G. Wood	284 J. Ball
183 T. Lester	300 G. and D. Hurn
186 J. H. Wilson	404 W. Adams
188 J. Snider, jun.	434 D. C. Pierce
191 O. Brakel, W. Hoehli, and W. Gunther	522 J. Howard
194 E. Atkinson	609 D. J., and J. Morris
201 M. A. Dietz	619 C. F. Vary
221 G. Haseltine	645 A. C. Henderson
250 W. E. Newton	819 R. W. Morrell
270 W. H. Cox	836 W. E. Newton
	893 W. M. Fuller
	1233 G. T. Bousfield

NOTICES OF INTENTION TO PROCEED WITH PATENTS.

From the London Gazette, July 18, 1865.

613 E. Humphreys. Marine steam boilers.	
616 T. Turton. Shaping file blanks.	
635 J. H. Wilson. Measuring the human body.	
637 A. E. Aubert and G. E. M. Gerard. Shoes.	
642 F. Tolhausen. Breech-loading fire-arms. (A communication.)	
648 J. Shanks. Watercloset apparatus.	
661 W. H. James. Carriage ways.	
665 W. D. Allen. Railway wheel tyres.	
669 V. Delperdange. Connecting tubes or pipes.	
670 J. E. G. and O. H. Freeman. Varnishes.	
680 J. Samuel and S. Milbourne. Preparing flax.	
684 C. Johnson. Tee-piece and valve.	
687 J. Gareilly. Cutting button holes. (A communication.)	
690 T. and H. W. Whitehead. Hackling flax.	
692 E. B. Wilson. Furnaces.	
693 J. W. N. pier. Wine glasses.	
701 R. Marsden. Rolling metals.	
708 F. A. Barendlin. Breech-loading fire-arms. (Partly a communication.)	
709 J. Deas. Levers for railway switches.	
712 R. A. Brooman. Photographic images. (A communication.)	
714 E. D. Hodgson. Safes.	
722 N. N. Solly. Water twyers. (Partly a communication.)	
726 H. Chever. Keyless watches.	
729 A. P. Price. Sulphurous acid.	
738 W. Loeder. Permanent way of railways. (A communication.)	
740 R. Bell. Working railway signals.	
741 W. Brookes. Musical instrument. (A communication.)	
748 G. Ralston. Making clothing. (A communication.)	
763 F. Wise. Attaching buttons to fabrics. (A communication.)	
768 J. H. Kidd and J. C. Mather. Floorcloth.	
787 W. Arthur. Compasses.	
813 T. H. Saunders. Ventilation.	
816 L. A. Leins. Securing the frame in travelling bags.	
827 M. P. W. Boulton. Motive power.	
832 W. Loeder. Rails for railways. (A communication.)	
838 D. Arnold. Gun locks.	
855 W. Clark. Heating. (A communication.)	
869 J. Norris, jun. Grooming horses.	
886 R. O. Robinson. Cutting nails.	
1303 S. Pokutynski and M. Mycielski. Motive power.	
1456 R. A. Brooman. Oil from fatty matters. (A communication.)	
1484 H. Monier. Gas burner.	
1578 G. E. Meek and W. H. Howes. Fastenings for doors.	
1631 J. H. Johnson. Lamp burner.	
1673 N. de Becker. Umbrellas.	
1677 W. E. Newton. Surface condensers. (A communication.)	
1717 W. Ingham. Pressing machines.	

1719 W. E. Newton. Amalgams of quicksilver. (A communication.)

The full titles of the patents in the above list can be ascertained by referring back to their numbers in the list of provisional protections previously published.

Opposition can be entered to the granting of a patent to any of the parties in the above list who have given notice of their intention to proceed, within twenty-one days from the date of the *Gazette* in which the notice appears, by leaving at the Commissioners' office particulars in writing of the objection to the application.

PATENTS ON WHICH THE STAMP DUTY OF £10 HAS BEEN PAID.

2002 C. E. and J. Green	2052 O. F. Morrill
2007 T. Hill	2080 R. Barrett
2035 T. G. Ghialin	2085 W. E. Newton
2042 R. Dunn	2077 T. Meriton
2040 W. Gossage	

PATENTS ON WHICH THE STAMP DUTY OF £10 HAS BEEN PAID.

1591 J. Fowler, jun.	1711 J. Musgrave
----------------------	------------------

LIST OF SPECIFICATIONS PUBLISHED

For the Week ending July 8, 1865.

No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.	No.	Pr.
2074	0	2103	0	4311	0	1021	0	8213	0	6213	0
2088	0	8210	0	4211	2	4212	0	4213	0	4213	0
2089	0	10210	0	4211	4	8213	0	10213	0	4214	0
2095	0	4210	0	4215	0	4214	0	4213	0	8214	0
2096	0	4210	0	8216	0	4215	0	6214	0	4214	0
2098	0	4210	0	10217	0	4216	0	8215	0	10214	0
2100	0	8210	0	4218	2	4217	1	4216	1	4214	1
2101	1	0211	0	10219	0	10218	0	4217	0	4215	2
2102	0	10211	0	4212	0	10219	0	10			

NOTE.—Specifications will be forwarded by post from the Great Seal Patent Office (publishing department) on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post Office Order, made payable to the Post Office, High Holborn, to Mr. Bennett Woodcroft, Great Seal Patent Office, 25, Southampton-buildings, Chancery-lane.

LATEST PRICES OF MATERIALS USED IN CONSTRUCTION.

TIMBER, duty 1s. per load, drawback 1s.	
Teak - load	£12 0
Quebec, red pine - do	£10 0
Yellow pine - do	£10 0
St. John, N.B., yellow - do	£10 0
Quebec oak, white - do	£10 0
Birch - do	£10 0
Elm - do	£10 0
Danish oak - do	£10 0
Memel fir - do	£10 0
Riga - do	£10 0
Swedish - do	£10 0
Maats, Quebec red pine - do	£10 0
Yellow pine - do	£10 0
Lathwood, Danian, fm 7 10	£10 0
St. Petersburg 8 10	£10 0
Deal, per C., 12 ft. by 3	£10 0
by 9 in., duty 2s. per	£10 0
load, drawback 2s.	£10 0
Quebec, white spruce 14 0	£10 0
St. John - do 13 0	£10 0
Yellow pine, per re-	£10 0
duced C.	£10 0
Canada, 1st quality - 18 0	£10 0
" 2nd " - 13 0	£10 0
14 10	£10 0
15 10	£10 0
16 10	£10 0
17 10	£10 0
18 10	£10 0
19 10	£10 0
20 10	£10 0
21 10	£10 0
22 10	£10 0
23 10	£10 0
24 10	£10 0
25 10	£10 0
26 10	£10 0
27 10	£10 0
28 10	£10 0
29 10	£10 0
30 10	£10 0
31 10	£10 0
32 10	£10 0
33 10	£10 0
34 10	£10 0
35 10	£10 0
36 10	£10 0
37 10	£10 0
38 10	£10 0
39 10	£10 0
40 10	£10 0
41 10	£10 0
42 10	£10 0
43 10	£10 0
44 10	£10 0
45 10	£10 0
46 10	£10 0
47 10	£10 0
48 10	£10 0
49 10	£10 0
50 10	£10 0
51 10	£10 0
52 10	£10 0
53 10	£10 0
54 10	£10 0
55 10	£10 0
56 10	£10 0
57 10	£10 0
58 10	£10 0
59 10	£10 0
60 10	£10 0
61 10	£10 0
62 10	£10 0
63 10	£10 0
64 10	£10 0
65 10	£10 0
66 10	£10 0
67 10	£10 0
68 10	£10 0
69 10	£10 0
70 10	£10 0
71 10	£10 0
72 10	£10 0
73 10	£10 0
74 10	£10 0
75 10	£10 0
76 10	£10 0
77 10	£10 0
78 10	£10 0
79 10	£10 0
80 10	£10 0
81 10	£10 0
82 10	£10 0
83 10	£10 0
84 10	£10 0
85 10	£10 0
86 10	£10 0
87 10	£10 0
88 10	£10 0
89 10	£10 0
90 10	£10 0
91 10	£10 0
92 10	£10 0
93 10	£10 0
94 10	£10 0
95 10	£10 0
96 10	£10 0
97 10	£10 0
98 10	£10 0
99 10	£10 0
100 10	£10 0

METALS.	
IRON:—	
Welsh Bars, in London - per ton	£ 10 0
Nail Rods - do	£ 10 0
Hoops - do	£ 10 0
Sheets, single - do	£ 10 0
Staffordshire Bars - do	£ 10 0
Bars, in Wales - do	£ 10 0
Rails - do	£ 10 0
Foundry Pig, at Glasg. No 1	£ 10 0
Swedish Bars - do	£ 10 0
STEEL:—	
Swedish Keg, hammered - do	£ 10 0
Swedish Fagot - do	£ 10 0
COPPER:—	
Sheet & Sheathing, & Bolts - per ton	£ 10 0
Hammered Bottoms - do	£ 10 0
Flat Bottoms, not Hamd - do	£ 10 0
Cake and Tough Ingot - do	£ 10 0
Best Selected - do	£ 10 0
Fine Foreign Copper - do	£ 10 0
Yel. Metal Sheathing & Rods - per lb.	£ 10

THE
MECHANICS' MAGAZINE.

LONDON: FRIDAY, JULY 28, 1865.

THE ATLANTIC TELEGRAPH.

THE news that has reached us since our last publication relating to this enterprise has been of a somewhat chequered character, but on the whole there seems at this time of writing great promise that we shall during the first or second week in August have the gratification of stating that Europe and America are again united. The first operations towards the submergence of the heavy shore end of the cable were not commenced until Friday, the 21st, on account of the delay which took place in the arrival of the steamer "Caroline," which was very much detained on her voyage owing partly to the fact that in some respects she proved to be far from a satisfactory ship for the purpose, but more on account of the heavy weather and the dead weight of 600 tons in her hold, the unyielding immobility of such a freight being very objectionable in a rough sea; and had it not fortunately happened that she fell in with the "Great Eastern," which took her in tow during the last part of her voyage, it is highly probable that a much more serious detention would have resulted. As to the shore end it may be mentioned that it is, we believe, the strongest and heaviest yet constructed, while at the same time, owing to its peculiar structure, it is for so large a cable far from unwieldy, being a perfect marvel of flexibility. Its foundation or centre is the main cable. Around this is wound, up to a diameter of nearly 2in., a wrap or padding of tarred jute yarn to serve as a foundation for the outer armour. This consists of twelve strands of galvanised iron wires, each strand consisting of three wires of the gauge No. 4. These strands are laid in a spiral direction round the padded main cable. The entire weight is 20 tons to the mile, and the strength sufficient to anchor a line of battle ship. The diameter over all is 3in.

The end of this monster rope was landed at Foilhammon Bay on the south-western coast of the island of Valentia, at half-past ten a.m. on the 22nd, and sufficient of it was at once drawn ashore to reach to the top of the cliff, beneath Bray Head, and so on to the office of the company, which consists at present of a wooden erection improvised for the occasion for the accommodation of the Atlantic Company and of the Magnetic and International Companies, by which latter companies the telegrams will be brought to and conveyed from the public until the Atlantic Company can establish separate wires for their own business from Valentia to London and Liverpool. The cable is carried from the shore up a natural cleft in the rock, into which it will ultimately be bricked. The end having been stripped and brought into the office, signals were soon established between the "Caroline" and the shore, when the continuity and insulation were found to be all right, and signals by Morse's printing instrument good.

Until the completion of the submergence of the cable by the "Great Eastern," and satisfactory proof that it is in proper order for transmitting messages, it is entirely in the hands of the Telegraph Construction and Maintenance Company, who have charge of the testing and every other operation connected with it up to that period, the electrician and other officers of the Atlantic Telegraph Company being merely present on board the paying-out ship for the purpose of watching and reporting proceedings to the directors of that company. Their staff accordingly at once prepared to ascertain the electrical state of the shore end, when it gave a result of four hundred and fifty-eight millions of British Association units per nautical mile, which is much above the con-

tract standard, and is remarkably good considering that this portion of the cable has been coiled away dry in the hold of the "Caroline," as it was not possible in her to keep it under water like the main cable on board the "Great Eastern." At 2.33 p.m., on the 22nd, the signal gun fired from the "Caroline" announced that she was commencing to pay out the shore end. By 4 p.m. she had paid out about 8 miles; at 5 p.m. the contractors' staff again took the insulation test, when it was found that owing to submergence in the cold sea water the insulation increased from four hundred and fifty-eight millions of units to six hundred and fifteen millions, and while on this point it may be mentioned that the test was taken again at 8 p.m., when the insulation had further increased up to six hundred and ninety-nine millions of units, 12 miles being paid out; again at 10.15, when a further increase up to one thousand and seven millions was observed, 21 miles having been paid out; again at 11.20 p.m., when the insulation showed a still further increase up to one thousand three hundred and twenty-six millions per nautical mile, after 23 miles had been paid out; all this improvement being due to the cooling of the gutta-percha after being submerged. At 11.30 on the same night the whole of the shore end had been paid out successfully, and by 9 a.m. on Sunday the 23rd, the "Great Eastern" arrived off Bray Head from Bantry Bay, where she had lain awaiting the completion of the work allotted to the "Caroline," and preparations were forthwith commenced for making the splice between the cable on board the "Great Eastern" and the extremity of the shore end. For effecting this object more readily the thick wires of the shore end commenced to taper at about 500 yards from its completion, and continue to do so until the mass is brought down to nearly the size of the main cable. The end from the "Great Eastern" being lowered from her stern into the "Caroline," the operation of splicing commenced, and the manufacture of the splice occupied from 2.15 to 4.30 p.m. This being done, a careful test was made from the shore of the whole 2,300 nautical miles, now in circuit, when the whole was found to be in perfect order, and as regards insulation in a very high condition. The "Great Eastern" then fired a salute of three guns and entered upon her work of paying out.

No conversation is allowed to go on between the ship and the shore during the process of submergence, unless indicated as being absolutely required by the state of the cable, but signals—unintelligible—pass every moment through it to show that it is uninjured. The speaking, when required, is performed by an apparatus invented by Mr. Desauty, the electrician to the Telegraph Construction and Maintenance Company, and has been used on board the "Great Eastern" up to the time of her sailing, the employees having been thoroughly trained with manipulation. Five ordinary cells of Daniell's battery are used for signalling, and forty cells of the same apparatus are kept ready for testing insulation, should it be found necessary to take it from the shore.

Each fifty miles of cable paid out is notified to the shore by a signal more than ordinarily emphatic and in an opposite direction from those regularly flowing through the cable to denote its vitality. A similar course is adopted to indicate every fifty miles run by the "Great Eastern," and in this way the shore is enabled without conversation with the "Great Eastern" to keep up a comparison between distance run and cable expended.

The signal above referred to informed the anxious watchers at Valentia, at 10 p.m. on Sunday night, that the first fifty miles had been deposited in the sea by the "Great Eastern," but before the time had arrived for the next signal some anxiety was created by the discovery that a fault had developed itself in some portion of the cable. The

"Hawk," a steamer of great power, built some time since for the purpose of being used as a Confederate cruiser, but stopped by the Government, and since purchased by the Telegraph Construction and Maintenance Company, was at once despatched on full steam to the "Great Eastern," while the "Caroline" went out to the splice, and during the whole of Monday, the 24th, the intelligence having reached London of the hitch that had taken place, there were among the friends of the undertaking great but groundless fears as to the success of the enterprise. At length at 10 a.m. on Tuesday, the welcome intelligence was received that the cable had been cut and repaired, the splice satisfactorily made, and that all was again going well. This favourable state of things has happily continued up to the present time—Wednesday night—and the latest telegram that has been received announces that 200 miles of cable have been paid out by the "Great Eastern," and that all is now going on satisfactorily. It is amusing to see the antics of the most pompous of the cheap daily papers, which has earned for itself the cognomen of "The Little Thunderer," in relation to the laying of the cable. It predicts failure, and half rejoices over the "hitch" which occurred on Monday. Whether the enterprise be successful or not, it is satisfactory to know that wordy newspaper writers had nothing to do with its failure or its success. All of them, no doubt, will be very wise after the event.

We observe by our advertising columns that the Directors of the Atlantic Telegraph Company are already moving energetically towards the creation of a second cable in the event of the first being successful. A meeting of the shareholders is called for August the 9th, in order to authorise the issue of additional capital, and we understand that the Company has also opened a negotiation with the Telegraph Construction and Maintenance Company for the manufacture, during the winter, of this second cable, with a view to its being laid during the summer of 1866. This will enable them to adopt a more popular tariff than the one they have just announced, and which they defend in an explanatory statement just issued on the ground that they have no experience as to what the amount or nature of the business may be, and that if the tariff be fixed at such a rate as will attract all kinds of miscellaneous messages it will not be possible to get through the work with the limited means afforded by one cable, and consequently messages of great moment may be arrested in their progress and delayed so unreasonably as to bring the whole affair to a dead lock. The charges, however, are stated to be only experimental and subject to reduction immediately that it is seen that the cable can efficiently perform a much larger amount of work than is presented for transmission at the high prices.

(To be continued.)

THE HISTORY OF AEROSTATION.*

IN noticing last week the results of some of the most recent experimental researches in the upper regions of the atmosphere, the idea that the anterior history of ballooning had had but little justice done to it more than once presented itself to our mind. Our ideas, however, upon this point have since been entirely reversed by the appearance of the volume now before us upon the subject. It is a fact that, beyond the outlines to be found in encyclopædias, no general synopsis of the science of aerostation has hitherto been published in England, with the exception of Monck Mason's brief account in 1836. The French have had the story of their balloon experiments twice told since 1850, although the number of their ascents and the list of their aeronauts are both more than doubled by

* "Astra Castra, Experiments and Adventures in the Atmosphere," by HARRON TURNER, the Prince Consort's Own Rifle Brigade. London: Chapman and Hall, 193, Piccadilly, 1865.

those of the English. In a speech made by the Prince Consort on the 21st March, 1850, he observed, "I conceive it to be the duty of every educated person closely to watch and study the time in which he lives, and, as far as in him lies, to add his humble mite of individual exertion to further the accomplishment of what he believes Providence to have ordained." Acting upon the principle here involved, Mr. Hatton Turnor has endeavoured, in a voluminous and profusely illustrated work, to do justice to the subject of *aërostation* by giving an authentic, consecutive, and detailed history of the science from the earliest to the latest times, and in this endeavour he has well succeeded. His account is not confined to England, but wherever an adventure has occurred or a courageous attempt has been made it has been recorded by him. The author dedicates the volume—no mean offering—to his parents, in grateful remembrance of their care and affectionate religious teaching. The effects of this care and teaching are conspicuous throughout the work, which, while it maintains a high character as a scientific production, is nevertheless imbued with an unobtrusive yet perceptible spirit of religion, of which science is here clearly shown to be the handmaid. And if one branch of science may be deemed more worthy than another of this relative position, it is certainly that which bids us leave earth behind us, and, soaring beyond the clouds, make our finite way towards the unrevealed realms of the Infinite. The history of the rise and progress of *aërostation* extends backwards for at least eighty years, during which period many pamphlets, letters, engravings, and caricatures have appeared in reference to the subject. All these and like productions have been carefully collated and formed into a summary. Franklin observed of the science, "It is an infant, it will grow." This observation still holds good, and although since Franklin's time considerable advances have been made, yet it is only so recently that public attention has been diverted from speculative dreaming to practical working in a really scientific direction that we may repeat his words with truth. A confidence in ultimate success is inspiring those who have patiently and laboriously considered the question in a mathematical and scientific point of view, whilst mathematical deductions clearly teach us to hope for the practicability of *aërial navigation*. These mathematical deductions, and the discoveries and inventions relating to the uses which have hitherto been made of the atmosphere, are here described in a manner worthy of that confidence to which we have adverted, and of the lives sacrificed in unavailing attempts. The progressive improvements in building vessels to navigate the waters have been made by slow and painful degrees. It was a long step from the coracle of the ancient Britons to the highly-finished, powerful, and swift vessels of the present day. And yet from the outset man had materials at hand perfectly suitable for his purpose. Wood readily floated on water, and it needed no deep investigations nor peculiar inspiration to determine the form best suited for a vehicle of transmission. But with *aërostation* the case was widely different; the difficulties at first were plainly far greater. It required centuries of research, aided by many accidental discoveries, to determine the properties of air, and as yet we have only the power of visiting the atmosphere, there to be driven to and fro at the mercy of the winds. But the mastery of atmospheric currents and the power of steering through them at will, if not witnessed by the present, will doubtless be accomplished by no distant generation. And the reasonableness of these views will appear when it is remembered what incredible progress has been made in marine navigation within the short period that has elapsed since the first steamer claved the waters of the Clyde.

If it were necessary to show the very modern date at which *aëronautics* first occupied attention, or rather, if we wished to prove that

anciently this branch of science had no existence, we have only to refer to the story of *Dædalus* and *Icarus*. The ancient poets and philosophers were clearly under the impression that the nearer they approached the sun the greater the heat experienced; otherwise they would not have promulgated the notion that the wax whereby the wings of *Icarus* were united to his body by his father, melted on account of his soaring too high above earth. It is certain that in those days of fables no one had ascended five or six miles vertically through the atmosphere, and had returned to record his experiences. But it is enough to notice in passing this and other imaginary and real, but fruitless, attempts to cleave the air, although our author, who can better afford the space than we, devotes a whole chapter to the sayings and doings of all ages and countries upon the subject. This chapter, however, is not without interest, and although it is upon what Sir Bulwer Lytton designates as the "normal clairvoyance of poets' imagination," it yet embodies all the known experiments prior to the year 1783. These experiments include attempts at flying, ballooning and sailing in the air by means of variously constructed apparatus. Quitting the realms of poetry and speculation for things more practical, we arrive in the third chapter at the period when the Brothers *Montgolfier* invented the *aërostat*. The history of the *Montgolfier* family is traced by our author from very remote times, and he does all honour to the various members, and to the ingenious brothers to whom, in 1783, *Louis XVI.* granted letters patent for the invention of their *aërostatic machine*. This patent was not consequent upon mere hypotheses or representations, but it was granted after several experiments had been most successfully made before the king. The letters patent set forth that his majesty had no doubt but that the invention would cause a memorable epoch in physical history, and furnish new means to increase the power of man, or at least to extend his knowledge, and these words have proved somewhat prophetic.

Messrs. *Montgolfier's* first public experiment was made on the 5th of June, 1783, at *Annonay*, near *Lyons*, with a balloon 110ft. in circumference, and capable, when inflated, of holding about 22,000 cubic feet of gas or heated air. Attached to the base of the balloon was a timber frame, having 16 square feet of area, the weight of balloon and frame being about 300lb. The machine was inflated by burning straw and wool beneath it, and when released it ascended, and in ten minutes had reached a height of 6,000ft. It then proceeded in a horizontal direction for 7,000 or 8,000ft., after which it fell gently to the ground. While these experiments were being prosecuted in France, in England *Watt* and *Cavendish* were discovering the composition of water, and shortly after the *Annonay* ascent the news of this discovery reached Paris. This led to a public subscription for defraying the expense of making inflammable gas (hydrogen), the materials for which were expensive. A globular bag of varnished silk about 12ft. in diameter was made, and this was designated a *ballon*, or great ball, hence our *balloon*. The process of inflation occupied from the 23rd to the 26th of August, 1783—1,000lb. of iron filings and 498lb. of sulphuric acid being required to produce the necessary quantity of gas—and on the 27th the ascent took place, amid great ceremony, from the *Champ de Mars*. The balloon rose to a height of 3,123ft. in two minutes, when it entered the clouds. After remaining in the atmosphere for about forty-five minutes it fell at *Gonesse*, a village fifteen miles from the *Champ de Mars*, much to the horror of the villagers, who ultimately shot the unearthly monster, and pitchforked what they supposed to be its stinking skin to shreds. This treatment is not much worse than that which Mr. *Coxwell's* "Research" has just received at the hands of those who went out to save it, and who, as Mr. *Coxwell* observes,

must have regarded it as some monster of the deep requiring immediate despatch. The French Government, however, to prevent future misapprehensions, issued an advertisement, explaining the mysteries of *aërostation*. Perhaps our own Government, with its fostering care for science, might do well to enlighten the dolts inhabiting certain parts of the British Islands upon the same points. Balloons made of paper and of goldbeaters skin now became common, and amateur *aëronauts* began to increase and multiply. *Montgolfier* sent sheep and fowls up, which descended with the balloon unharmed, and this success led to the idea of an ascent by man. Scarcely ten months from the date of *Montgolfier's* first *aërostatic* experiment *M. Pilâtre de Rozier* publicly offered himself to be the first adventurer in the newly-invented *aërial machine*. *Montgolfier* constructed a new fire balloon of oval shape, 48ft. in diameter, 74ft. high, and weighing about 1,600lb. In this machine *M. de Rozier* made several public ascents, varying in height from 84ft., the first, to 330ft., the last of the series, the *aërostat* being detained in all cases by ropes. *M. de Rozier*, however, shortly afterwards made an ascent accompanied by the *Marquis d'Arlandes*, when they sailed about over Paris and its environs unfettered by any connections with the earth.

Although the news of *Montgolfier's* first experiment spread rapidly and widely, the subject was not taken up outside France for some months. In England the first *aërostatic* experiment was made by *Count Zambecari*, an Italian, who constructed a balloon of oil-silk, which was 10ft. in diameter and weighed 11lb. On the 25th November, 1783, this balloon was inflated with hydrogen, and was launched from the *Artillery Ground* at one o'clock in the afternoon. Two hours and a half later it was found at *Graffan*, near *Petworth*, in *Sussex*, forty-eight miles from London. To pursue the subject in chronological order we must return to France, where the first *aërial voyage* with an inflammable air balloon was made on the 1st December, 1783, from the *Tuileries*. The balloon was constructed by the Brothers *Robert*, famous philosophical instrument makers of the time, and Professor *Charles*, a young but experienced physicist, was entrusted with the direction of the experiment. The balloon was made of varnished silk, the upper portion being covered with a net. It measured 27ft. in diameter, and had attached to it a car or boat of basket-work, measuring 8ft. by 4ft. by 3ft. 6in. deep. The *appareil d'aërostation* was created by *M. Charles* in connection with this ascent, for in this balloon he introduced the varnished silk, the valve to regulate the escape of gas, the car, which he attached by ropes to the lower edge of the network covering, the ballast to regulate, and the barometer to measure ascent and descent. In fact, it may be said that the art of *aërostation* at once attained perfection in *Charles's* balloon, and no essential change or improvement has since taken place. The gas balloons took their name from this *aëronaut*, and were afterwards known as *Charlières*. The first voyage was safely accomplished by *M. Charles* and one of the *Roberts*, who travelled from Paris to *Neale*, a distance of about twenty-seven miles, in an hour and three-quarters. After landing *M. Robert*, *M. Charles* shot up again and made a series of barometric and thermometric observations. Almost simultaneously with the adoption of gas for balloons in France, experiments were made with the same view at *Philadelphia, U.S.*, a singular coincidence certainly, but by no means infrequent in the history of discovery and invention. On the arrival of the news of *M. de Rozier's* exploit, Messrs. *Rittenhouse* and *Hopkins*, members of the *Philosophical Academy of Philadelphia*, instituted a series of experiments which resulted in the construction of a machine with forty-seven small hydrogen balloons, attached to a car, or cage, as it was called. After some preliminary trials with ropes attached, *Mr. James Wilcox*, a carpenter, made an ascent

on the 28th December, 1783. He pursued a rapid course towards the Schuykell river, and when nearing it effected a rather precipitate descent by cutting slits in the balloons as pre-arranged. Such was the first experiment in the New World, and here, for the present, we leave the subject of aerial navigation, which we have pursued from its earliest dawn to the time at which it assumed a practical character and became of scientific importance.

PAPER PIPES.

WHENEVER the inventive mind succeeds in adapting a material to a specific purpose, whereby the claim of novelty can be covered and public utility apparently served, the said mind is sure to indulge itself in visions of the future, wherein it sees its pet fancy applied to all manner of possible and impossible purposes. A few years since the scientific world was aroused by the threatened application of paper to all the varied purposes for which iron, stone, and wood have been and still are usually employed. Pipes, tanks, ships, forts, armour plates, and even guns, were in the long category of things that were to be of paper. When the Chinese wish to describe a blustering, harmless fellow, they designate him a "paper tiger." Such would doubtless be the character of the last item in the above list. A paper gun, however, might prove harmless to foes rather than to friends. But paper pipes involve a degree of rationality which entitles them to consideration; they will stand investigation without fear of bringing ridicule upon the materials of their manufacture. The strength of paper, although well known for long past, does not appear to have been turned to any specific account, nor has the material been applied beyond the ordinary purposes for which it is used in everyday life, except perhaps the papier mâché manufacture. At any rate its adaptation as a substitute for iron, in the manufacture of gas and water pipes, is comparatively new. These pipes are composed of paper and bitumen, and the process of their manufacture is very simple. Paper of a width equal to the required length of the pipe, is passed through a cistern of molten bitumen. Upon a cylinder or core having its diameter equal to the required bore of the pipe, this paper is then wound, under pressure from a heavily-weighted cylinder, revolving in connection with the core. This insures an equal distribution of the bitumen, and compactness of material throughout the pipe. The thickness, and consequently the strength, of the pipe is regulated by the amount of paper coiled on the core. When the pipe leaves the rolling machine the core cylinder is withdrawn, and the interior of the tube is coated with an insoluble waterproof composition. This coating protects the paper, and, forming a highly glazed surface, diminishes the resistance of friction, an important point as regards water pipes. A composition of bitumen and sand is applied to the exterior of the pipe, which protects it against the evils to which iron pipes are liable.

The junction of these pipes is effected in several ways; where they are to be subjected to pressure a flanged iron coupling is used. In this case the end of the pipe is forced against the inner projecting flange of a suitably formed iron socket, and an annular space of wedge section is then filled in with some of the substance used in lining the tube. A perfect and strong connection is thus made between the iron socket and the pipes, which are then jointed together by screw bolts passing through the iron flanges. An india-rubber washer between the faces of the flanges serves to make the joint watertight. Pipes not subjected to great pressure are jointed by means of a thimble or ferrule joint, the ferrules being made of the same material as the pipes and the spaces being filled in with molten bitumen. The individual qualities possessed by paper and bitumen render these substances in conjunction peculiarly adapt-

able, with judicious manufacture, to the purpose of pipe making. Although, as already stated, advantage has not hitherto been taken of the great strength of paper, yet it has frequently been observed that it would one day form an important material in manufactures where tensile strength is an object. It only awaited the discovery of a substance suitable for combination with it, and in bitumen it appears to have a very strengthening and a protective ally. The good qualities of the two unite to produce a material well adapted to the purpose of pipe making. These pipes offer a strong resistance to external and internal pressure. In a paper read before the Institution of Engineers in Scotland, by Mr. O. Marquet, it is stated that bitumenised paper pipes, of 3in., 4in., and 5in. diameter, and $\frac{1}{4}$ in. in thickness, have been tested both singly and joined together, and have been found to withstand a pressure of 500lb. on the square inch without showing the least sign of weakness, either in the pipe itself or at the joints. The bursting pressure of these pipes has not as yet been ascertained, as on the occasion when they were experimented upon, the machines used were not sufficiently powerful for the purpose. If a coating of a bituminous composition is found to protect iron pipes so well, we may expect a great deal from a pipe partially composed throughout its entire structure of bitumen. Being bad conductors of heat these pipes have the advantage of protecting water or gas from injurious changes of temperature. The nature of their composition renders them proof against the attacks of acids or alkalies, so that they are suitable for a variety of purposes to which metal pipes are inapplicable. They are also bad electrical conductors, and therefore useful as protectors for underground telegraph wires. Their elasticity is far greater than that of iron, and they are, therefore, less liable to burst from shocks or concussions; water, too, has been frozen in them without any injury resulting to them. Compared with iron pipes, the specific gravity of those of bitumenised paper is as 1 to 5, whilst the cost of the latter is stated to be about one-half that of the former.

Like everything else, these pipes must, after all, be judged not so much by the reasonableness of their pretensions as by the stern and uncompromising results of working. They must submit to the practical test before they can be either approved or condemned. To take goodness for granted because evil does not seem to be, or to reject as bad that which only does not appear to be good, is a principle no more applicable in engineering than in any other branch of science. The test must be based upon facts, and not upon fancies. Let us see, then, what these pipes have done to earn a reputation. They have been laid to a considerable extent in France; in Paris alone many thousand pounds have been spent for this purpose, some of the pipes laid being 2ft. in diameter; gas as well as the water companies have used them. Mr. Marquet states that he has seen pipes which were laid in 1854, and when taken up last year they seemed none the worse. Very much, however, depends upon the asphalt used, for some of the asphalt laid down in the streets of Paris lasts from ten to fifteen years, while an equal thickness of it sometimes does not stand a quarter of that time. In Germany some of these pipes have been in use over two years, and no charge appears to be brought against them. Turning attention closer home, we find that Mr. Copland, the borough engineer of Paisley, had a line of 4-inch paper pipes laid, and he found great difficulty in getting the pipes jointed, and the service pipes connected with them. Where the service pipes were connected bitumen was run over to make all tight; but the pipes were not in six months before they required repairing. The pipes had become quite soft near their junction with the iron pipes, and at these points were continually leaking. They were, however, fitted with the thimble joint, and not with the far more effective flanged iron coupling previously noticed. The

softening of the pipes must arise either from the action of the water upon them from within, or from moisture on the outside. Now, bitumen is not liable to oxidation, and if both sides could be covered with it, so as to completely insulate the bitumenised paper from the iron joint, at the same time covering the iron portion itself, both inside and outside, it is difficult to see how the paper pipe can decay.

The defects complained of by Mr. Copland appear to have arisen from a faulty method of union, but his objections do not apply to connections formed with the flange joint. The joints of the pipes Mr. Copland used were made by having a hole bored in the middle of the thimble or ferrule, opposite the ends of the pipes. Through this hole the molten bitumen was filled in, so as to make the joint tight. Now, by boring a hole in the middle of the coupling, a weakness was created at the very place most strength was requisite. Two evils are likely to arise in the making of this kind of joint. First, the hot bitumen comes directly in contact with the ends of the pipes being joined, by which they cannot fail to be softened, and possibly allow the molten bitumen to get into the inside of the pipe. Another evil likely to occur is that air bubbles are formed in the substance of the bitumen filled in, by which the joint is also rendered imperfect. These defects are avoided by boring two holes in the coupling, one at each side, at some distance from the end of the pipe. The molten bitumen is poured in at one hole and the air escapes at the other, so that air-bubbles have little opportunity of forming. The ends of the pipes are also less liable to become softened, and, by treating the ends with a dose of tar before putting them together, the molten bitumen is prevented entering the pipe. The great point, however, after all, is the quality of the pipes, and this depends on the material as well as on the manufacture. There are wide differences in pipes of British and continental manufacture. The bitumen of foreign countries is purer than that of this country; that from Hamburg is about as pure as can be had, that from the Pitch Lake of Trinidad only excepted. The paper pipes which have done such good work in Paris were made with the Hamburg bitumen. There is however at present insufficient evidence whereon to base a conclusive opinion, but apart from this, the invention is one which appears likely to extend in its application, and will in time probably open up a new field of commerce.

REVERBERATORY FURNACES.

IN the various processes connected with the manufacture of iron many kinds of air furnaces are used, but it is chiefly with those employed in rolling mills and for the forging of wrought iron we have now to deal. It has been deduced from practical experience that forge or heating furnaces are most effective when constructed on the reverberatory principle. This is, no doubt, mainly due to the very high temperature required. The furnaces in question, however, vary in some of their details in different localities, or according to the peculiar views of those who have the control of them. In some cases they are formed with a solid base of brickwork or masonry. In others a large opening is left in connection with the asphalt, iron plates constituting the roof of the space. Either plan answers the purpose, though the latter is frequently preferred, as it offers in some degree a check to neglect on the part of the furnaceman, whose omission of duty would be revealed by the falling through of the cinder into the opening below. Among the first points to be attended to in the formation of a reverberatory forge furnace are the height and area of the chimney. The latter should on no account be less than 350 or 400 in., and the former not less than 40 or 50 ft. A number of furnaces may be made to work with smoke ways leading into one tall and capacious stack, provided the outlets do not meet each other, but are placed at varying heights, and

all have an upward turn. This is, indeed, a *sine quâ non* in all cases where high temperatures are required, for if flues meet each other the draught will be neutralised. The exact shapes of furnaces must, of course, be regulated and governed to some extent by the kind of work to be done, whilst the area of grate surface must depend somewhat on the quality of coal most readily obtainable in the localities in which they are situated. Large and gaseous coals demand less surface than those which are small and of inferior combustive force.

Allowing that its chimney gives sufficient draught power, the efficient and economical working of a furnace will largely depend upon the proportions of the area over the fire bridge and those of the space at the junction of the flue with the working chamber. These in some cases may be made adjustable by a careful damper arrangement, but a better plan is to calculate their dimensions properly at first, and construct them accordingly. It is of much importance, too, that the bottom of the furnace and its neck should be kept in good repair until the whole requires rebuilding. It is almost needless to say that for the successful resistance of the destructive effects of high temperatures, the best materials in the shape of fire-bricks must be employed in furnaces of this description. Anything short of this will render constant repairing necessary and entail great expense. In this matter as in others the first cost is frequently the least, if only that cost be judiciously expended. It is usual to build furnaces of a width uniform with that of the fire-grate, though occasionally the working chamber is made rather wider. We consider uniform widths are best, because all furnaces have a tendency to widen by force of wear and calcination at the part named. It is important also that attention should be paid to the reverberatory or dip of the roof of the furnace towards the flue end. Unless this be so the term "reverberatory" becomes a misnomer, and the heat is carried off to the stack without effecting its mission. The descent should be at least carried to as low a point as the level of the furnace bed, or even lower, if the draught power of the chimney be adequate to the requirement. By error in this direction a great amount of fuel and time may undoubtedly be wasted, and the most unsatisfactory consequences will ensue as regards the productiveness of the furnace.

Where boilers for the purpose of supplying steam hammers are applied to forge furnaces, they should not interfere injuriously with the working of the latter, and, as a rule, they do not. The surplus heat will generate sufficient steam, and very little, if any, extra consumption of fuel will be induced. It is not desirable, however, to carry such an arrangement to too great an extreme, nor to tax boilers beyond what they are calculated easily to effect. Independent of the auxiliary or secondary part played by boilers attached to forge furnaces, this mode of getting up steam would be found excessively extravagant; that is to say it would never answer commercially to keep such furnaces in action for the mere sake of generating steam. It is only when employed in actual combustion with and supplementing the duties of the furnace, that such boilers can be economically used.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

Paper as a Material for Sugar Moulds—Vitrification of Photographs.

THE moulds used in sugar-refineries are sometimes made of clay, sometimes of zinc, or of plated copper, occasionally of glass, but, at least in France, most frequently of sheet iron, either painted or enamelled. The great disadvantage of such moulds is that the paint or enamel upon them invariably cracks after a time, whereupon, if the defect be not instantly remedied, the portion of the metal

which the crack lays bare rapidly oxidises, causing the mould to deposit upon the sugar spots of rust, which very greatly deteriorate its value. This disadvantage on the part of the moulds in common use led MM. Dufournet et Cie., of Clichy, about seven years ago, to turn their attention to papier maché as a material for sugar moulds, and it is stated by M. Clémendot, in a paper on "The Industrial Applications of Stiffened Pasteboard" which he lately read before the Society of Civil Engineers of France, that nearly a hundred thousand of their paper moulds have now been in use for nearly six years, without any one of them having required repair. The first cost of the paper moulds is somewhat greater than that of iron moulds, but iron moulds cost an average of a franc and a half each per annum for repairs, so that, to set against the excess of first cost on the part of the hundred thousand paper moulds, is the saving of the nine hundred thousand francs which six years' repairs of the same number of iron moulds would have cost. The paper moulds are still in excellent condition, so that the saving already realised does not represent by any means the full amount of the economy to be effected by their use. This is the first instance, we believe, in which papier maché has received any extensive industrial application, but it is not likely to be the last. The lightness and cheapness of this material, together with its non-liability to breakage and its power of resisting the action of chemical agents, render it well adapted to replace glass, porcelain, and gutta-percha, for a great many purposes. MM. Dufournet et Cie. have begun to make of it basins and funnels for photographers, cells for electric batteries, and many other similar articles.

M. Regnault has presented to the Academy of Sciences some specimens of vitrified photographs produced by a still more elegant method than that which was described in these columns a few weeks since. This method is the invention of MM. Maréchal and Tessié du Motay, and is a development of the principles which serve as the basis of photography in salts of silver upon paper and collodion. The inventors begin by dissolving four parts of caoutchouc in a hundred parts of benzine. They add to the solution so obtained one part of plain collodion dissolved in ether, and then pour the mixture upon the glass or porcelain plate, vessel, or other object upon which they design to produce and fix the intended photograph, so as to cover with a thin film of it the surface upon which the photograph is to be produced. After having been dried, either in the open air or in an oven, this caoutchouc-collodion film adheres to the glass or porcelain very firmly. When the film is quite dry, a layer of iodized collodion is poured over it. This second film unites ultimately with the first, and thus acquires a resistance at least equal to that of a sheet of caoutchouc of similar thickness, a resistance which no kind of collodion possesses." The next step is to immerse the double film thus prepared in a nitrate of silver bath, and then to expose for a picture, either in the camera or in the printing frame. The picture may be developed by any of the solutions ordinarily employed for that purpose, but must be fixed by the successive action of two baths, one containing a solution of iodo-cyanides, and the other of cyanides (alkaline). When thus fixed, it is immersed for a few minutes in a solution of sulphate of protoxide of iron, or in one of pyrogallie acid, or of any other acid which will reduce the salts of silver. It must now be intensified by means of the reaction of either pyrogallie, gallic, or formic acids, or of a solution of sulphate of protoxide of iron, upon a solution of acid nitrate of silver. If what is to be produced is a vitrified photograph upon glass, intended to be seen by transmitted light,—to be viewed, that is, as a transparency,—an amount of intensifying will be necessary which will require from twelve to fifteen baths; but if the picture, whether it be on glass, porcelain, or

other silicious material, is to be viewed by reflected light, from four to six intensifying baths will be sufficient. During this process of intensifying the pictures must be well washed, two or three different times, alternately in a bath containing iodo-cyanides and in a bath containing simple cyanides, and immediately afterwards in a bath containing pyrogallie acid, solution of sulphate of protoxide of iron, or any other body capable of reducing silver-salts. The object of these frequent alternate washings in iodo-cyanide and cyanide baths is to dissolve away every particle of silver which does not actually go to the formation of the picture,—both the non-adherent argentic powder which is precipitated upon the whole surface of the picture by each intensifying bath, and the pulverulent or incompletely reduced silver, which, in ordinary photography, constantly remains united to the metallic silver after the development and fixing of the picture, resisting the solvent action of the hyposulphites of ammonia, and that also of alkaline cyanide baths, employed alone. It is in the means which it affords of removing this superfluous silver, without touching the completely-reduced silver forming the picture, and of using as the medium on which first to produce the picture a film strong enough to permit of many washings and intensifyings without the picture getting displaced or torn, that the essence and value of MM. Maréchal and Tessié du Motay's very beautiful and ingenious process consist. The washing in a reducing bath with which they follow each series of washings in the iodo-cyanide and cyanide baths is for the sake of rendering the surface of the metallic silver forming the picture again neutral, or acid, and so bringing it into the condition in which the intensifying bath can best act upon it. After the picture has been sufficiently intensified, it is immersed for an hour or more in a bath of either chloride or nitrate of platinum, or in one of chloride of gold, or in one of chloride of gold and one of nitrate of platinum alternately. This causes the silver of the picture to be partially replaced, in the one case by platinum, in the second by gold, and in the third by a mixture of platinum and gold. "The object," say the inventors, "of these several baths substitutive of the film of silver is to vary either the colour or the nature of the picture after it becomes vitrified. For when we propose to obtain in the muffle furnace, by the action of boracic or silicic fluxes, pictures of a greenish black colour, we previously immerse the picture in a bath of chloride or nitrate of platinum; when, on the contrary, we wish to obtain black pictures, we immerse them consecutively in baths of chloride of gold and nitrate of platinum. Lastly, when we desire to produce pictures in gold, we substitute exclusively baths of salts of gold." On leaving the platinum or gold bath the picture is washed in a saturated solution of ammonia, or in a solution of an alkaline cyanide, and is then dried, covered with an india-rubber or gutta-percha varnish, and submitted to the action of the muffle until the organic matters are all burnt away and only the metals forming the picture are left. It is then cooled, covered with a boracic or silicic flux, and finally exposed to an orange-red heat, which vitrifies it. The photographic picture is then rendered absolutely permanent,—a fact which points to the probability of the vitrification process being resorted to, not merely as a means of producing pictures upon glass, for stained windows and the like, and of ornamenting objects of ceramic art, but also as a means simply of preserving photographs from decay.

It is stated that the cause of the suspension of telegraphic communication with India consists in a break in the submarine cable about 350 miles from Boshire, and that measures are in progress to effect the necessary repair as soon as possible. At the same time the condition of the land portion of the line through Asia is described to be unsatisfactory.

PHOTOGRAPHIC TENTS.

LETTERS PATENT have been granted to Mr. Richard Wheeler Thomas, of Pall Mall, for an invention which has for its object the rendering tents and apparatus employed in taking photographic pictures not only as convenient as may be for ready transport from place to place, but also for obtaining the most ready use of the various apparatus and materials employed in the process of photography. For this purpose the case or box, together with the requisite flexible material constituting the tent, are arranged and combined in such a manner as not only to be capable of being readily expanded for use and of being contracted in dimensions for transport, but also the arrangement is such that the apparatus and materials employed in the process of photography, and which are used in the tent, are secured in the positions they occupy when in use, both when the box or case is expanded into a tent and also when contracted for transport, so that when the box or case is opened for use, the bath, the plate box, and chemicals are all in position within the tent, and they retain their positions when the box or case is contracted for transport, thus dispensing with the packing and unpacking of the apparatus and materials heretofore more or less necessary when employing portable tents.

The tent when in use is fixed at the top of a tripod or other suitable stand, as has been usual with other forms of portable photographic tents, and according to this invention the tent is constructed of a box or case having the two ends and back fixed to the bottom, whilst the front is hinged at its bottom edge in such manner that it may fold down. The height of the ends and of the back and front is such that the inclined bath may be secured and retained in the position in which it is used, so that when in use and when being transported it will retain its position. The bath is of the ordinary form, and has a fluid-tight cover, as heretofore. It is preferred that this bath should not be absolutely fastened on the bottom of the box or case, but safely secured thereto in the proper inclined position, so as to admit of its being removed, or, if desired, it may be capable of being adjusted to a greater or less inclination. The top or cover of the box or case is made in two parts, which are respectively hinged to the two ends of the case or box; when closed the cover comes just above the top of the inclined bath. The height of the tent depends on the length of the box or case, as the height added to that of the box when opening it into a tent will be half the length of the top or cover of the box or case. In order that the box or case should be strong and yet light, it is preferred that the back, the two ends, the front, and also the two parts of the top or cover should be framed in wood and have panels of paper or millboard, but such parts may be otherwise constructed and of other materials.

A flexible covering (usually of black cotton velvet lined with yellow calico) is formed and affixed in the following manner:—At the back of the box or case the flexible material is fixed to and along the upper edge of the back; the flexible material is also fixed to the back edges of the two parts constituting the cover or top of the box or case, and the flexible material is also fixed to the edges of these two parts of the cover or top where such edges meet together when shut, and in such manner that when these two parts are open and stand upright the flexible material forms a top or covering to the tent as well as part of the back of the tent. The flexible material in front is formed in a similar manner to that in which like flexible materials have been used in other constructions of portable photographic tents; but in order that the upper part of the front may be held above the head of the person who is manipulating, if the height of the tent is not sufficient for this purpose, two sliding bolts are used, having spring catches to retain them in position when they are slid out to support the flexible material. The two bolts are employed one at each end of the tent, and they are applied to the two parts constituting the top or cover of the box or case. These bolts are arranged to slide diagonally at the front angles of the two parts of the cover or top, by which the outer ends of the bolts when in use will stand at a higher position than the other parts of the top of the tent. The flexible material is formed tubular, as heretofore, so that the person enters it from the lowest end, and in order to close it in

all directions as heretofore, so as to shut out the light from entering in this direction, he either places the lower parts of the flexible material between his legs, as heretofore, or he raises the flexible material so as to fasten it round him under his arms by hook and eye or otherwise. The two parts of the top or cover of the box or case when raised into an upright position are retained open by means of a stretcher or rod at the top or by light rule-jointed stretchers at the back, or by both, or by any convenient means.

It is preferred that the inclined bath should be secured and held in the position it is required when in use on the bottom of the box or case, and at the left-hand end thereof, whilst the box for the plate and also the case for the bottles of chemicals and other articles are secured to the bottom at its right-hand end in the positions required when in use. The gutta-percha sink is placed in the centre of the bottom of the box or case, and the camera is arranged to be strapped or fixed to the bottom of the tent when placed on the cover of this sink. The respective localities in which these apparatus are secured may, if desired, be varied, so long as they are secured in the positions required for their use when the tent is opened. A window or windows and provision for ventilation will be made as in other portable photographic tents; these openings are to be at the back or ends of the case or box. By this construction and combination of a photographic tent and apparatus the same will, when for transport, consist of an oblong rectangular case or box, having within it the apparatus and materials requisite for the process of photography, such apparatus and materials being secured in position and ready for use immediately on raising the two parts constituting the cover or top of the box or case, whilst in order again to render the whole fit for transport the flexible material will be folded into the interior, the front of the box or case will be raised, and the two parts of the cover or top will be closed or shut down and fastened, the apparatus within retaining the positions in which they were when being used. The dimensions of the box will be from 30 in. to 36 in. long, 18 in. to 20 in. from back to front, and from 14 in. to 16 in. high.

CLYDE STEAM DREDGERS.

At the conclusion of Mr. Duncan's paper on the Construction and Working of the Clyde Steam Dredgers, the following discussion took place:—Mr. W. Simons said he had built the screw hopper barges that were used in connection with the Clyde dredgers, and it was only within the last two years that they have been adopted: previously 350 of the square punts had been required to carry away the dredged material, but four of the barges now did the work of the 120 punts formerly attending one dredger. Each barge carried 300 tons, and was 120 ft. long, 24 ft. beam, and drew 8 ft. of water when loaded; the engine was 40-horse power with 21 in. stroke, driving a screw 7 ft. diameter, and the speed was the same whether loaded or empty, amounting to 9 miles per hour. The Clyde trustees contemplated abolishing the old punts altogether and employing only the screw hopper barges for removing the material dredged. The barges were loaded in about 70 minutes, and ran down the river and up Loch Long to a distance of about 50 miles from Glasgow, where the whole of the dredged material was discharged through the flap doors in the bottom. Hydraulic gearing was used to close and open the bottom flap doors in two of the barges, and in the others a common windlass had been applied, which had been found to work better. The total expenses of working the dredgers and barges were about £2 5s. per day, including wages, fuel, oil and tallow; and the result of employing the screw hopper barges had been to reduce the cost of dredging from about 1s. per ton of material when the punts were used to only 4d. per ton with the barges, making a saving of between £19,000 and £20,000 per annum.

By this system of dredging it might indeed be possible, he thought, to form an inland town into a seaport, such as Preston, Lancaster, Manchester, or Paris, where there was already an outlet into the sea for carrying away the dredged material; all that was required would be dredgers and barges of sufficient power and capacity for the quantity of work to be done, since the double dredgers now at work in the Clyde raised each about 1,100 tons per day in regular continuous work, as stated in the paper. About the year 1800, when the depth of the river at Glasgow was only about 3 ft. at high water, the annual revenue from ships coming up the Clyde was only £3,320; but in 1825, when the river had been deepened by dredging to 12 ft., allowing vessels of 300 tons burthen to come up, the revenue had

increased to £9,000; while in 1863, with the depth increased to 22 ft. at high water, the revenue amounted to £118,000, and the river was deep enough to float the "Black Prince" armour-plated frigate of 6,000 tons burthen, built by the President, the largest ship that had yet been launched in the Clyde. Only 4 or 5 minutes were required to discharge the whole 300 or 320 tons of material carried by the hopper barge. There were twelve doors or six pair at the bottom, hinged to the iron hopper, and lined inside with timber; and the doors were let down for discharging by releasing the chains that held them up while the hopper was full. The chains passed over pulleys in the longitudinal iron girder which extended over the hopper from end to end.

Mr. W. E. Newton remarked that a dredging machine on a different principle had been used very successfully in different parts of the United States for many years, consisting of a large bucket fixed at the end of a long lever worked by chains; the bucket was lowered and dragged along the river bottom to fill it, and was then lifted by the lever and swung round horizontally to the required position for discharging the stuff, which was let fall through a door in the bottom of the bucket into the barge beneath. The bucket raised about 26 cubic feet of soil at each stroke on an average. That appeared to him a simpler contrivance than the dredging machines ordinarily used in this country, such as those described in the present paper; it was at any rate much less expensive, and allowed of swinging the bucket round into any position required for discharging into the barge, whereas with the ordinary dredging machines the barge had to be brought to a particular place for receiving the stuff from the spout of the dredger. The gearing for working the lever was driven by a self-acting friction clutch, somewhat similar to that described in the paper, except that in the American machine the inner or driving pulley was surrounded by a bridle provided with friction blocks, which were tightened against the pulley when running forwards, but slackened in running backwards, so that the clutch simply held on in working, and was not limited to slip when the resistance exceeded a certain amount, but would transmit the whole power of the driving machinery, its only purpose being to avoid breakage from sudden jerks, and to release itself for running backwards. He had seen a machine on that principle, known as the "American excavator," used experimentally some years ago on the Eastern Counties Railway, in the neighbourhood of Brentwood, for excavating a cutting, and all the gearing in it was worked with friction clutches of the same kind. That description of clutch was indeed much used in America for all sorts of machinery, and was found very economical and effective in preventing breakages, by allowing the gearing to yield under any undue strain. He had never known it fail in transmitting the full driving power, and thought it would have some advantage over the friction wheel described in the paper.

Mr. H. Mandalay inquired whether the friction wheel in the dredger described in the paper was found effectual in work, by always slipping, whenever the buckets came into too hard ground or took too deep a scoop into the soil, or met with any other obstruction.

The Secretary said he had seen the dredger at work in the Clyde, and the friction wheel was found to answer its purpose thoroughly. The screws of the friction blocks were adjusted originally to the pressure required for the ordinary working, and then continued unaltered, without requiring any further attention in working. He had seen the bucket frame lowered slightly below the proper working position, causing the buckets to bite gradually deeper in the bed of the river, until the resistance was just sufficient to overcome the friction of the blocks when the buckets stopped while the driving pulley or ring continued to revolve outside the friction wheel; but on slowly raising the bucket frame again the friction wheel gradually started again as the resistance diminished, and the whole worked with complete smoothness and readiness. The engineer working the dredger stated that the friction wheel had given no trouble, and there had not been any difficulty in keeping it adjusted exactly to the point desired for working. The same kind of friction clutch was also applied to the lifting gearing by which the end of the bucket frame was raised and lowered; so that all portions of the machinery were started and stopped quite gradually, the friction gear being continually called into action to meet the irregularities in the level and material of the bed of the river and prevent any straining of the machinery.

Mr. J. Shepherd asked whether the material raised by the dredgers was used for agricultural purposes, as a manure, and whether it had any commercial value for such purposes, since it appeared the sewage of Glasgow was all discharged into the Clyde, and would, therefore, be deposited in the bed of the river.

The President replied that the quantity of sewage matter deposited in the river bed formed so very

small a portion of the quantity of material raised by the dredgers, that it had never been thought to apply it as a manure, and it had no commercial value for such a purpose. In reference to the American dredger a somewhat similar apparatus was occasionally used on the Clyde at the present time in dredging alongside the wharfs in the harbour, consisting of a rake or plough fixed on the end of a long pole, which was worked from the bank by a number of men or from a punt on the river, and was moved along the edge of the wharfs for clearing out the material from the face of the quay, and removing it within reach of the dredger, in cases where the dredger could not be conveniently worked close alongside.

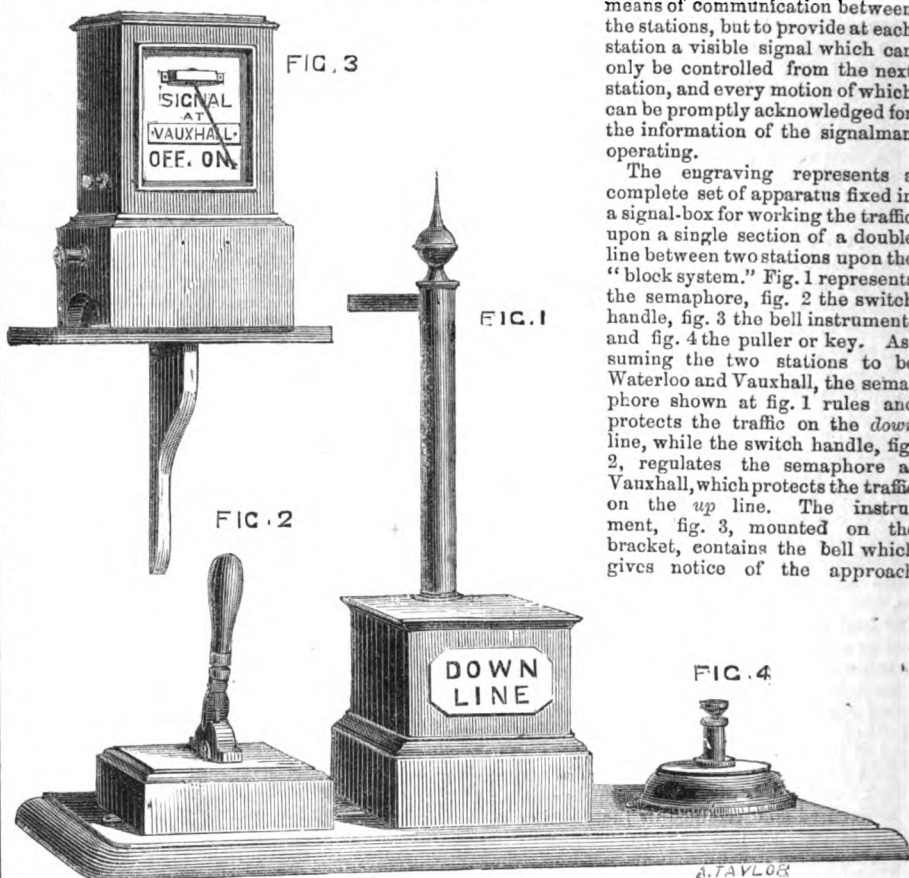
Mr. J. J. Birckel observed that the depth of 13ft. at low water in the Clyde at Glasgow, and 22ft. at high water, would give a tidal fall of only 9ft., and he inquired whether that was the actual tidal fall at Glasgow, since at Liverpool, on the same coast, the tidal fall was as much as 32ft. He asked also whether there was not a risk of some portion of the material deposited in Loch Long being brought back into the river by the tides, as the loch was so close to the mouth of the Clyde; in the case of the Mersey no deposit was allowed to be made at any part of the approaches to the river for fear of interfering with the channel.

The President explained that there were so many arms of the sea to fill near the mouth of the Clyde, and so many bends in the river itself, that the tidal wave did not come up to Glasgow in the same quantity as in the Mersey; and the rise and fall at Glasgow averaged, therefore, from 7ft. to 9ft. only, very seldom more. Loch Long was a blind arm of the sea, with no outlet at the further end, and no navigation through it, and there was very little tide in it, and as it was about 200ft. deep where the barges were discharged, there did not appear any probability of any portion of the deposit being carried back by the tide. From the paper that had been read it was obvious that the dredging machines employed in the Clyde had been productive of very remarkable advantages to Glasgow. From a depth of water of only about 3ft. at the beginning of the present century the river bed had now been deepened to about 22ft. at Glasgow at high water within the space of about sixty-three years. But it was since the introduction of steam navigation into the Clyde that the greatest part of this improvement had taken place. The steam tugs drawing vessels up and down the river first led to the rapid deepening of the bed by dredging; and then the increase of revenue arising from the larger burthen of the vessels trading to Glasgow afforded the means of increased expenditure upon the dredging operations; thus both the depth of the river and the advantages to the city went on increasing simultaneously.

PREECE'S ELECTRIC SIGNALS.

The fourth part of the Board of Trade report on recent railway accidents has just been printed, and its perusal certainly leads to the conclusion that no accident could point more strongly to the necessity of having every train properly guarded by signals on the line, than the double collision which occurred on the 7th of June last, near Keynsham Station, on the Great Western Railway. We need not enter upon the details of this catastrophe; they are fresh before the public. Our purpose is to notice the observations made in Colonel Yolland's report upon the necessity of a compulsory system of perfect signalling. The accident, or rather accidents, in question, consisted of two collisions which occurred within eight minutes of each other at the same station, and they afford good illustrations of what may happen at any moment on any line of railway where the traffic is worked with no other precaution than an interval of time in the departure of trains following each other on the same line of rails, and that vigilance on the part of the Company's servants which is so unceasingly taxed for hours together. This system of working traffic by an interval of ten minutes in the times of departure of following trains was probably the best that could be devised when it was first established. But since the electric telegraph has been successfully adopted for the maintenance of an interval of space between following trains on the same line of railway, it can no longer be said that an interval of time is the best or safest expedient that can now be made use of, and it is certain that it is constantly failing. Colonel Yolland's opinion is that it is very questionable whether a discretion should be left to the directors of railway companies as regards the adoption of the electric telegraph for the safe working of their traffic. If this depended alone on the inspecting officers of the Board of Trade, it is probable that no new railways would in future be opened, unless arrange-

PREECE'S ELECTRIC SIGNALS.



ments had previously been made to enable the officers of the railway companies to work the traffic with an interval of space between following trains; but they can only report a line as unfit for public traffic "by reason of the incompleteness of the works or permanent way, or the insufficiency of the establishment," and it seems doubtful whether under these words the introduction of the electric telegraph could be insisted upon. The interference of the legislature is apparently necessary to enable such an improvement to be generally carried out, and to oblige existing railways companies to adopt it. It appears to be something more than a pity that railway directors should so systematically neglect to avail themselves of tried and proved means of conducting the traffic on their lines under conditions of safety. They have escaped one session and are slowly drifting on towards another, and they will awake some morning to find themselves tied and bound by the chains of an Act of Parliament, when they will vainly regret opportunities lost when they were unfettered.

A system of signalling which commends itself by its conformity to the requirements indicated in Colonel Yolland's report is illustrated in the accompanying engraving. It is the invention of Mr. W. H. Preece, of Southampton, and has been for some time past in successful operation on the London and South-Western Railway. It has recently been adopted on the Glasgow and Paisley joint lines, which is the first instance of its adoption in Scotland. Mr. Preece's object in the development of his plan has been to carry out what is known in railway management as the "block system." This system provides that no two trains shall be upon the same rails at the same time, between two stations, thus interposing between the trains an interval of space instead of a mere interval of time. With a view to the carrying out of this idea, signal stations are established along the line at distances of not more than two miles apart, and these are connected by means of an ingenious electric apparatus, so that each is made to act as a distant danger signal for the adjoining lengths of line, no train being allowed to pass any station until its predecessor has been telegraphed as safely past the next. The practice of telegraphing trains from station to station has, for some years past, been carried out in various forms on certain railways. This contrivance, however, seems in several respects an improvement upon the methods formerly adopted. Mr. Preece's object

has been not merely to afford a means of communication between the stations, but to provide at each station a visible signal which can only be controlled from the next station, and every motion of which can be promptly acknowledged for the information of the signalman operating.

The engraving represents a complete set of apparatus fixed in a signal-box for working the traffic upon a single section of a double line between two stations upon the "block system." Fig. 1 represents the semaphore, fig. 2 the switch handle, fig. 3 the bell instrument, and fig. 4 the plunger or key. Assuming the two stations to be Waterloo and Vauxhall, the semaphore shown at fig. 1 rules and protects the traffic on the down line, while the switch handle, fig. 2, regulates the semaphore at Vauxhall, which protects the traffic on the up line. The instrument, fig. 3, mounted on the bracket, contains the bell which gives notice of the approach

and nature of the advancing trains, while the indicator upon its face faithfully repeats and acknowledges to the man at Waterloo the correct working of the semaphore at Vauxhall, and its proper comprehension by the man at that station. The plunger or key, fig. 4, sounds, on its depression by the man at Waterloo, the bell at Vauxhall, and at the same time causes the indicator at that station to register the semaphore at Waterloo either at "on" or "off" according to whether it is in the one position or the other. The state of the semaphore in the engraving indicates that a down train is proceeding from Waterloo to Vauxhall, and the position of the indicator shows that an up train is advancing from Vauxhall. While the semaphore arm remains at danger, as shown, no second train would be allowed to proceed from Waterloo, and similarly, until the up train had arrived at Waterloo, and the semaphore had been lowered at Vauxhall by pushing over the switch handle at Waterloo, no second train would be allowed to leave Vauxhall. It is thus seen that a clear and unmistakable danger signal is raised behind each train to protect it from any following train, and that while the signal remains elevated and its indications are regarded—so that two trains cannot follow on the same section of line—no accidents from collision can possibly arise.

The instructions which are given to signalmen who work this system of signalling are as follow:—1. No train or engine is to be allowed to pass your box unless the electric signal for the section into which it is about to proceed stands at "all clear." 2. On the approach or arrival of the train or engine at your box, you will, provided the electric signal stands at "all clear," at once signal it on the bell to the next station in advance, thus—If a passenger train by two beats; if a goods train by three beats; if a special or engine by four beats. 3. This signal will be acknowledged by the corresponding station, by throwing his switch-handle over to "on," thereby placing the electric signal at your station at "danger," and protecting the line from any train following that already in the section. 4. You will acknowledge this signal by returning one beat of the bell. 5. On the arrival of the down train at ———, or the up train at ———, the signalman at that station will pull his switch-handle over to "off," thereby removing your danger signal, intimating the arrival of the train and clearing the line. 6. This you will acknowledge by one beat on the bell. 7. In case any obstruction exists upon the line to