ASBESTOS AND ITS APPLICATIONS.

ASBESTOS, a Greek word signifying "unconsumable," is the name given to a peculiar variety of the amphibole or hornblende family of minerals, of which the chemical composition is chiefly silica, magnesia, alumina, and ferrous oxide. It is most common in Canada and Italy, but in one form or another is also met with in considerable quantities in certain parts of Scotland, in Sweden, Corsica, the Ural Mountains, and Australia. But little appears to be known as to the formation of asbestos. It occurs in regular layers or veins, and, as found, is generally a greyish-green rock made up of innumerable fine crystalline fibres which become soft, white, and of a silky lustre when separated from each other by slight pressure. The thickness of the veins varies considerably in different localities, from a thin sheet in the case of the variety known as mountain leather, to several inches in the deposits of the delicate amianthus found in the older crystalline rocks, in the Pyrenees, the Alps of Dauphiny, the St. Gothard, the Savoy, and Corsica. A single fibre of asbestos, heated in the flame of a blowpipe, readily fuses to a white enamel, the varieties containing most iron being more easily fused, but in the mass it resists the heat of an ordinary flame, and for this reason it has recently begun to attract considerable attention. Unfortunately the fibres of asbestos differ from all other known fibres in having a perfectly smooth surface and in being much less elastic than those of either animal or vegetable origin, in consequence of which all efforts to spin and weave them by modern machinery have until very recently entirely failed. In ancient times, however, the art of weaving asbestos into all sorts of useful drapery and dress material seems to have been well known, although it is possible that this was accomplished by spinning the fibres along with those of flax, and then destroying the latter by heat, a process still resorted to by some makers. At any rate it is stated that the bodies of the dead used to be wrapped in asbestos cloth to keep the ashes separate from those of the surrounding funeral pile, and at a later date it is said that Charlemagne had a tablecloth woven from amianthus, which he used to have thrown into the fire after dinner, to the astonishment of his guests. Chevalier Aldini, of Milan, had a complete dress with cap, tunic, gloves, and stockings made of asbestos cloth, and carried out very successful experiments by way of testing it as a protection for firemen.

In addition to amianthus and mountain leather, there are several other varieties of asbestos. We will, however, only name mountain cork, which is a brownish or dirty white deposit, less flexible and less regular than amianthus and mountain leather, and which is so light as to float on water; mountain wood, a soft, opaque, brownish coloured variety, which melts to a black slag before the blow-pipe; and lastly, the common asbestos which has recently been discovered in large quantities in Canada, in veins from 1in. to 2in. thick, and which is the kind most generally used for manufacturing the various articles to which we shall have occasion to refer.

The introduction of asbestos for such purposes as engine packing and jointing for pipes has been attended with very considerable difficulty. Of all materials it is perhaps that which requires the most careful manufacture and intelligence in adapting it to its special purposes, and when these have not been sufficiently exercised users have been disappointed, and have not unfrequently given up the trial in disgust. As with many new and important substances, asbestos has been looked upon by some as a sort of panacea, and recommended as such, while others have been so eager to sell that failure has often occurred from the use of some specially prepared form in a situation where those better acquainted with the trade would have known beforehand that it was totally inapplicable.

Having recently had an opportunity of inspecting the large asbestos manufactory of Mr. John Bell, we now propose to describe some of the more important uses to which this interesting material is being applied. Mr. Bell, though not the first to introduce asbestos goods into this country, has perhaps done more than any other person in developing the use of pure asbestos in all the multifarious branches to which it is now found to be applicable, and it is likely that before long further important developments will be made as the result of experiments which have been in progress for some time, and which are now being brought to a successful issue.

As we have before stated, the peculiarity incidental to asbestos fibre for a long time baffled all attempts to spin it into a yarn without the intermixture of a certain proportion of flax or other vegetable fibre, which of course could only be looked upon as an objectionable adulteration, and was only to be tolerated until other and better means could be discovered. Within the last few years, however, the difficulty has been overcome, and yarns capable of withstanding great tensile stresses can now be readily produced by machinery which has been specially constructed for the purpose. One of the most important applications of this yarn is for the manufacture of steam packings, of which a great variety are made, each description being designed to meet some special demand. In making packing it was at first not sufficiently recognised that the fibres of asbestos were apt to be largely charged with minute particles of pyrites, and until this fact was appreciated it was often found that the piston-rods were scored, the damage being attributed to the action of the asbestos itself, instead of to the impurities it contained. To obviate this defect it therefore became necessary, not only to carefully select the most suitable kind of asbestos for the purpose, but to thoroughly cleanse it from all stone and grit before spinning, for which duty machinery had to be adapted. The yarn now produced is quite pure and is capable of being woven into almost any kind of fabric. Fig. 1 shows the most common form of packing, in which the pure asbestos yarn is simply plaited up by machinery into a square or round rope, and for some time this was considered to be the *ne plus ultra*. It was first brought out by Mr. Bell in the year 1879, and was immediately adopted by the British and German navies, where its use is still continued. But it was soon ascertained that special cases required special treatment, and though the plaited packing was generally satisfactory, it became evident that something else was wanted in the case of steam engines with extremely high piston speeds, such as are now being introduced into the merchant service. To meet this demand the yarn was first woven into a cloth, which being slightly waterproofed with vulcanised india-rubber, was rolled up into a rope in much the same way as the canvas is treated in what is known as Tuck's packing, only without the rubber core. This packing, which is shown in Fig. 2, answered admirably, and is being much used in cases where the rapid destruction of ordinary packings gave rise to most serious inconvenience. In addition to the two varieties here mentioned, other forms are made, asbestos with soapstone being found to be excellent for locomotive work, while a more elastic packing, shown in Fig. 3, in which a core or internal band of india-rubber is introduced, is giving great satisfaction in

Fig. 1

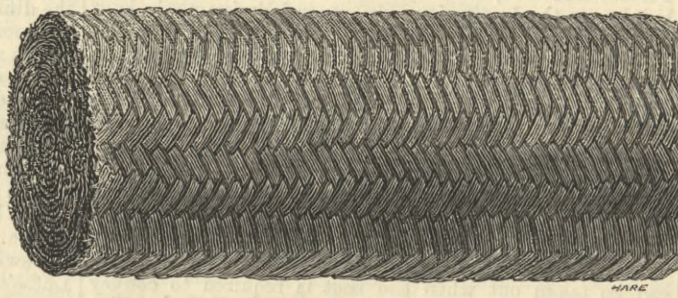


Fig. 2

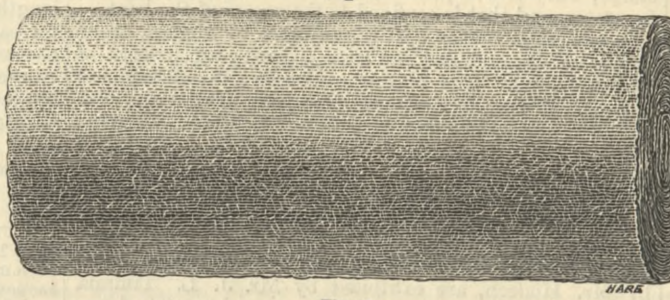
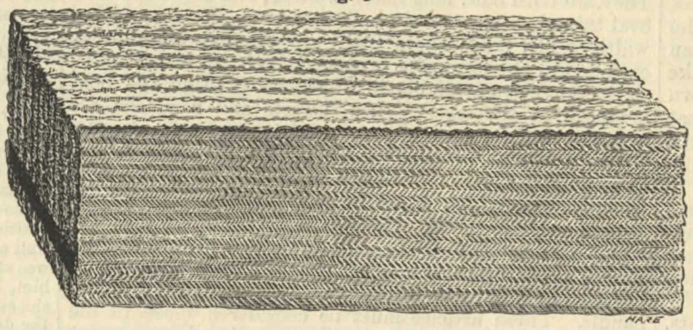
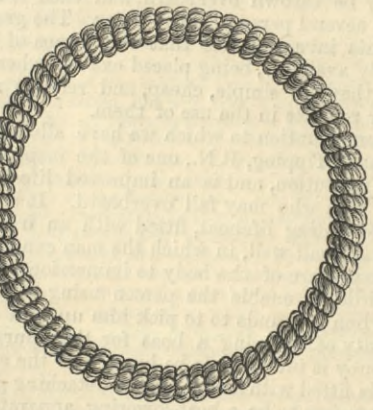


Fig. 3



the large glands of marine engines and other similar cases. This latter form has been designed to overcome the difficulties met with in working with steam of very high pressure, the economical advantages of which cannot be realised without a much more durable packing than most of those generally used. The enduring powers of this asbestos block packing are quite remarkable. In one case on being taken out after twelve months' working with steam of 70 lb. pressure, it was found to be perfectly good, and was accordingly replaced, while as an instance of its efficiency we can cite a case in which, after uselessly trying almost every kind of packing in a troublesome stuffing-box

Fig. 4



of a large pumping engine, the asbestos block packing was found to answer admirably, and the result has been that an average of $1\frac{1}{2}$ lb. to 2 lb. better vacuum has since been maintained in the cylinder.

It has often been erroneously stated that asbestos packing could be used without lubrication. No greater mistake could exist. It not only requires a good supply of oil, but demands careful attention on the part of the engineer in charge. With these it invariably gives satisfaction, and will last from five to ten times as long as ordinary packing, while without these it inevitably disappoints. In other words, if carefully manufactured and properly used, asbestos is the best material for packing the glands of steam engines; but if ignorantly made up and carelessly used it is probably the worst.

A great deal of yarn is woven into cloth, the increased use of which has been very marked during the last twelve months, and which is being adopted for a great variety of purposes. One noteworthy application is for fireproof curtains, and several of these have been supplied by Mr. Bell for theatres in Great Britain, the United States, and some of the principal cities in Europe. Curiously enough our Yankee cousins have not yet succeeded in spinning an asbestos yarn without admixture with vegetable fibre, and they have therefore been compelled to obtain all their cloth from Mr. Bell. So important, however, do they consider this material in regard to the prevention of the spread of conflagrations, that a company has been formed in New York with the sole object of extending its use in the shape of protective shields, either permanently fixed or applied in case of a sudden emergency. In relation to this application a fire shield was recently exhibited at a meeting of the Firemen's Convention held at Rochester, N.Y., and attracted very great attention. The shield consisted of a piece of pure asbestos cloth about 20ft. square, and supported on an iron frame. A pile of pinewood saturated with petroleum and tar was built on the windward side of the curtain and set on fire. The blaze was tremendous, and the heat so intense that persons could not stand within 50ft. of the burning mass on the exposed side. On the side protected by the shield, however, the heat was scarcely felt, and a dummy erection of wood and glass, which was placed close beside it, was not in any way injured. The curtain, of course, did not suffer, and was as good after the experiment as it was before. This asbestos cloth might be used in many ways to protect property from destruction by fire. A curtain suspended from the cornice of a building might be lowered in an emergency and effectually screen the entire front, and many industries where there is danger from fire might also be protected by lining the rooms where such dangerous work is done with asbestos cloth.

Another interesting application is in the filter invented by Mr. Maignen. This apparatus consists of a hollow perforated cone of earthenware, over which is stretched a specially woven asbestos cloth. On the outside a layer of the finely powdered filtering medium—Maignen's patent carbo-calcis—is automatically deposited by being mixed with the first water put into the filter. To cleanse the whole thing all that is required is to wash off the old filtering medium and deposit a fresh supply on the asbestos cloth, an operation very easily accomplished in a few minutes, and one which can be done without the trouble and expense of returning the filter to the makers.

For forming the joints of pipes exposed to the action of moisture, and for man and mudhole doors requiring frequent removal, asbestos woven cloth is very largely in demand. In these cases asbestos millboard, which is the cheapest form of jointing material, is comparatively worthless, if, indeed, it is not absolutely objectionable, from its permeability to water, which soaks through and attacks the iron of the bolts, and it was therefore necessary to devise a combination which would effectually resist the heat and damp. This is provided in what is known as asbestos and india-rubber woven sheeting, which is made in any thickness, and is supplied either in sheets to cut to the required shape, or in a tape 1in. to 2in. wide, which can be cut to length and bent to circle or oval without puckering. When all other materials have failed to give satisfaction this has answered admirably, and in the case of manhole and mudhole doors and feed-water pipes the joint can be broken twenty times without requiring renewal of the strip. The last application of the yarn which we shall mention, though the list is not exhausted, is in the manufacture of rope and cord. Having great tensile strength, and being unaffected by heat and damp, this material is being introduced for sash lines and for ropes of fire escapes. It is also adopted for covering rollers in print works, especially when aniline dyes are used, and in cases when it is exposed to great heat and to the action of hydrochloric acid. Asbestos cord has also been found to be the most effectual material for making the joints of the hot-air pipes for blast furnaces, which are exposed to an exceedingly high temperature. The jointing piece is shown in Fig. 4, and consists of an iron ring wrapped with the cord, which is simply put in place and nipped between two flanges. Previous to the manufacture of asbestos cord the rings were wrapped with spun yarn, which gave continual trouble, while the asbestos, being unaffected by heat, lasts a very long time.

We now come to an entirely different manufacture of asbestos, in which the rock, after being broken down and reduced to fluff, is pulped and formed by pressure into sheets from $\frac{1}{32}$in. to $\frac{1}{2}$in. in thickness. This millboard, as it is called, is used for making joints not exposed to the action of moisture, such as for dry steam, air, and gas. Much of the millboard in the market is made of very inferior material, chiefly waste cuttings and second-hand stuff, and, being devoid of long fibre, it is insufficiently bound together and soon disintegrates, while a great deal of that imported from abroad is impure, and contains as much as 10 per cent. of adulteration. When properly made and used with faced surfaces this material affords the easiest and most cleanly method of making a joint that we know of, while if the faces are previously painted over with boiled oil the danger of having a troublesome leaky joint is reduced to a minimum. The board is easily cut to the desired size, and as no time is required for drying and setting, steam can be turned on directly the bolts are screwed up. We speak from experience when we say that with no material with which we are acquainted can dry steam and air joints be made with more ease and certainty as with asbestos millboard. A much commoner and cheaper description, though it still possesses most of the essential qualities, is manufactured for fireproofing floors and ceilings. It is made in sheets about $\frac{1}{32}$in. thick, and is applied in the simplest possible way either above or below the joists. It is also used for lining the walls of wooden buildings, where from its non-conducting and fireproof qualities, it affords an immense protection in case of the outbreak of fire. For surrounding flues or covering the parts of a building exposed to the action of heat, or in the neighbourhood of a fire, it is also valuable. The step from millboard $\frac{1}{32}$in. thick, to paper, is apparently so small that it is not to be wondered at that many attempts have been made to produce an asbestos writing paper, which, from its indestructibility, would be invaluable in case of fire, for preserving charters, policies, agreements, and other important documents. So far, however, these efforts have not been successful, for though a paper has been made it has been too uneven in texture, and altogether too rough and akin to blotting paper to permit of its use as a writing material.

As an insulator of electricity asbestos in one form or another is greatly sought after. Millboard has for some time been used in the construction of dynamos, while cables and leads covered with plaited yarn have been adopted in many installations. The advantage of having as an insulator a material unacted upon by heat or damp is so obvious, that we venture to think there is a large future open to asbestos in this branch of electric work. Cheapness of production is, however, essential, as it will be brought into competition with materials which, though not possessing all its advantages, are more easily procurable and require less special adaptation in their manufacture.

The remaining uses of asbestos which we have to notice appear to be mainly in the production of fireproof cement and putty, for which there is considerable demand for certain kinds of joints, and in the manufacture of fire and acid-proof lumps, blocks, and bricks. The ordinary gas fire is familiar to everyone, and it will suffice to point out that asbestos enters largely into the composition of the artificial fuel upon which the success of the fire in a great measure depends.

In conclusion, we will just say that we have been tempted to dwell rather fully on the nature and applications of this interesting mineral, as we believe they are not generally known to our readers, and also because we feel sure it is very seldom that enough care is exercised in the selection of a packing or jointing piece, anything cheap and handy being used, whereas there can be no doubt that to make a satisfactory joint, either for a stuffing-box or pipe flange, it is necessary to apply a considerable amount of discrimination in the selection of the material.

LIFE-SAVING APPARATUS AT THE FISHERIES EXHIBITION.

IN some respects this department is disappointing, as, with the exception of England and the United States, no other country has contributed to it; and the American exhibit is really the only novelty to those visitors who take a special interest in the subject, as the apparatus shown by the Board of Trade, the lifeboats of the Lifeboat Institution, the various life-rafts, &c., are familiar objects, and were to be seen at the Naval Exhibition at Islington, and at the Alexandra Palace last year.

The United States exhibit is very complete, and is made more interesting by a collection of spirited engravings shown by the Century Company, illustrating the life and duties of the members of the United States life-saving service. The boats are totally unlike our English lifeboats, and are, in fact, not lifeboats at all, but surf-boats, designed for service in the surf on the flat coast and outlying bank of the east coast of the States. Three of these boats are exhibited, and the principal features of the best of them are enormous sheer, great lightness, and fine ends, bow and stern being nearly alike. No attempt is made to make them self-righting, or are they fitted with air-cases of any description, or any means of relieving themselves of water.

The apparatus for effecting communication with a stranded vessel by means of a hawser, is identical in principle with that used by the Board of Trade; the difference being that in America a small and very effective gun is used for throwing the line to the ship instead of a rocket, and is preferred on account of its greater accuracy of aim and extended range. The apparatus is much lighter and more compact than the English one, the total weight being only 700 lb., although more hawser is carried than on the English cart, which is drawn by horses, whereas the American cart has to be drawn by the seven men comprising the crew of a life-saving station, which is frequently situated at a desolate spot on the coast where no horses or other assistance are available.

Another feature of the American service is the life-car, a sort of pontoon made of thin iron, which travels on the hawser between the ship and the shore. This is only used when a large number of persons have to be rescued, as several people can be put into it at once, and their rescue effected more rapidly than with the ordinary breeches buoy, which will only carry one person at a time. Women and children are also protected from the intense cold of an American winter by means of the life-car. This exhibit is well worthy of inspection, and the officer in charge is most willing to give every information to visitors. It is to be regretted that other Governments have not followed the example of the United States in sending their life-saving apparatus. Can it be that they have nothing worth exhibiting?

The large prize of £600 offered by the Committee of the Exhibition for the best full-sized lifeboat, fully equipped and on a carriage, adapted to aid stranded or wrecked vessels from the shore in gales of wind and through heavy broken seas and surf, has only produced two competitors, probably owing to the great expense attending such an exhibit.

The Royal National Lifeboat Institution sends a magnificent example of its well-known self-righting boat on a launching carriage. This boat is 34ft. long by 8ft. 3in. beam, pulling ten oars double banked. This size is considered by the Institution the most useful for general coast work, and is adapted for sailing and rowing. The only peculiarities of this boat are that much camber is given to the keel, which is well rounded up at both ends, to make the boat easier to steer to meet the seas, and the addition of a large hollow fender outside the boat on each side. These fenders are placed very little above the water level, and as the boat is inclined the leeward fender materially increases the stability of the boat as it becomes submerged. These fenders are experimental, and will not be generally adopted by the Institution until experience has shown whether they answer the purpose for which they are intended. The boat is a splendid piece of workmanship, and was built by Messrs. Woolfe and Son, of Shadwell. The Institution also exhibits an interesting series of models, including one of the first English lifeboats, constructed by Greathead, and used at Shields. This boat had no end air-cases, and was not self-righting; and it was through her capsizing, and drowning a number of pilots, that attention was drawn to the necessity of providing an improved description of boat, and a competition took place from which the present type of lifeboat originated. The other models show the present form of boat, the Norfolk water-ballast sailing lifeboat, Richardson's original tubular lifeboat, a safety fishing-boat, &c.

The other competing lifeboat is shown by Messrs. Forrest and Son, of Limehouse, who were formerly the builders to the Institution. In general design their boat resembles that shown by the Institution; but has less sheer, a straighter keel, and side relieving scuppers instead of relieving tubes through the bottom of the boat, and a small fender close to the gunwale, and intended more for the protection of the boat when bumping against a wreck than for additional stability. This boat is rigged in a very heavy and complicated manner.

The other boats shown are intended for ships' use, and comprise a very fine one, built by Messrs. Woolfe and Son after the model which gained the gold medal of the Society of Arts. It is fitted with movable side air cases, which can be taken out when the boat is required to convey stores; but when in place the boat has very little capacity for water, and that is confined to the centre of the boat.

A somewhat similar boat is exhibited by Messrs. Leslie and Hamblin, and is fitted with a very good pattern of relieving tube. This boat is said to be self-righting, and although it has high end air cases, not having any iron keel, and being built with very little sheer, it is somewhat difficult to perceive how the self-righting quality is obtained.

The tubular form of boat originally introduced by the late Captain Richardson seems to be a favourite one with inventors, and several models of variations of this type are exhibited. Two full-sized boats of this type, patented by Mr. Hodson, are exhibited by Mr. J. L. Timmis. They are both 33ft. long and 9ft. beam, and consist of two oval tubes having a vertical dimension of 3ft. 4in., with a width of 2ft. 3in. These tubes are brought together at each end in the form of a boat, and both sides are alike, so that they are available in whichever position the boat is placed in the water. The thwarts and rowlocks are attached to the boat by lines, and have to be fixed after the boat is in the water. One specimen is constructed of iron and the other of wood, and the latter is most ingeniously put together. The iron boat has straight keels, but the wooden one has a considerable camber, which does not improve her appearance, as the upper keel falling towards both ends gives the boat the appearance of being hogged, but, no doubt, it makes her more easy to handle. These articles must be considered more in the light of life-saving rafts than of boats, and cannot compare for ordinary purposes with the other ships' lifeboats. The exhibits of life-saving apparatus other than boats contain no novelties of a practical character, Roper's bridge raft, Copeman's deck seat raft, &c., having been frequently described and illustrated.

Two unpretending exhibits are, however, worthy of notice. One is a model of a deck seat invented by Captain Pinhey, the superintendent of the Woodside Ferry at Liverpool. It consists of the ordinary deck seat of open battens, divided into short lengths, which can be easily lifted by one person. Underneath each length are placed three metal cylinders, 15in. long and 7in. diameter. In the event of the steamer foundering these light deck seats can readily be thrown overboard, and each is capable of supporting several persons in the water. The great advantages of this invention are that the means of safety are immediately available, being placed exactly where they are required; they are simple, cheap, and require no putting together or practice in the use of them.

The other invention to which we have alluded is shown by Lieutenant Tipping, R.N., one of the inspectors of the Lifeboat Institution, and is an improved life-buoy, to be used by a man who may fall overboard. It consists of a model self-righting lifeboat, fitted with an iron keel, and containing a small well, in which the man can sit and thus avoid the exposure of the body to immersion. It is fitted with a paddle to enable the person using it to approach the ship when it rounds to to pick him up, and thus avoid the necessity of lowering a boat for that purpose. The boat life-buoy is intended to be hung over the stern of the ship, and is fitted with a very simple detaching gear, which does not profess to be a boat-lowering apparatus, a large number of which are exhibited, one of the newest and best being McCollin's screw-jack davits, consisting of two double-action screw-jacks working the davits inboard and outward, each davit being pivotted on the deck. The jacks are connected by a rod, securing simultaneous action in working, and an ordinary winch handle is fitted to each end of the rod. By this means the boats are kept inboard, resting on chocks, and when required for use are readily slung outward; and as the action of the screw-jacks brings the davits into a perpendicular position, the boat is lifted clear of the chocks, without rendering it necessary to use the falls by which the boat is suspended from the davits. This gear seems eminently adapted for torpedo and other heavy boats.

The importance of connecting the lightships round our coast with the mainland by means of telegraphic communication has long been felt, and would be the means of saving a large number of lives, as news of wreck could be instantaneously conveyed to the nearest lifeboat station, whereas the existing signals of rockets and guns are frequently not observed until it is too late to render assistance. Moreover, with telegraphic communication, intelligence could be conveyed to the lifeboat crew of the exact position of the wreck, whereas at present they have, in the first instance, to proceed to the lightship making the signals to ascertain where their services are required; and thus much valuable time is often lost. Carrier pigeons have been tried without success, as these birds are unable to make progress against heavy gales and snow-storms. In 1870 an attempt was made to establish a floating telegraph station, about 600 miles from the Land's End; but the cable was soon destroyed by coming in contact with the ship's moorings, and the swinging of the vessel caused kinks and bends which damaged the gutta-percha core, and destroyed the continuity. Consequently this undertaking was abandoned. To overcome this difficulty the Telegraph Construction and Maintenance Company exhibit a model of a lightship which is kept continually swinging, and fitted with a cable through which an electric current can be passed, which rings the bell on board the model. The following is the method proposed to be adopted in order to overcome the difficulties hitherto experienced:—The lightship would be moored by two mushroom anchors and chains. These chains are shackled on to a mooring swivel, made with a hollow spindle—Bedwell's patent; one of the chains is constructed of double links—Lucas's patent—designed to protect the telegraph cable from the wear and tear of the constant dragging on the sea bottom. The cable is passed from the mushroom anchor up through the centre of this double linked chain, then through the mooring swivel and over a bow-sheave into the ship. By these means fouling of the cable with the moorings is prevented. Between the swivel and the ship a revolving joint in the cable—Lucas's patent—automatically prevents it becoming twisted as the ship swings to the wind and tide. A sufficient length of cable is coiled in a tank or on a winch on board, for paying out when, from stress of weather, it is found necessary to veer out more chain. A contract has been entered into with the Corporation of the Trinity House to connect the "Sunk" lightship with the shore at Walton-on-the-Naze. We shall watch with interest the experiment about to be tried with this device by the Trinity House.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending June 16th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,990; mercantile marine, Indian section, and other collections, 4459. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 2260; mercantile marine, Indian section, and other collections, 1199. Total, 18,908. Average of corresponding week in former years, 17,649. Total from the opening of the Museum, 22,109,425.

A LADY ENGINEER.—While so much has been written about the great Roebling East River Bridge, and those who have had a share either in planning or building it, there still remains one whose services have not been publicly acknowledged. A few days ago it was mentioned that Mrs. Washington A. Roebling, the wife of the great engineer, had driven the first team over the bridge, but it did not say how fitting it was that she should be accorded the honour. Since her husband's unfortunate illness Mrs. Roebling has filled his position as chief of the engineering staff. A gentleman of Trenton, well acquainted with the family, said that as soon as Mr. Roebling was stricken with that peculiar fever which has since prostrated him, Mrs. Roebling applied herself to the study of engineering, and she succeeded so well that in a short time she was able to assume the duties of chief engineer. Such an achievement is something remarkable, and to illustrate her proficiency in engineering one instance will suffice. When bids for the steel and ironwork for the structure were advertised for, three or four years ago, it was found that entirely new shapes would be required, such as no mill was then making. This necessitated new patterns, and representatives of the mills desiring to bid went to New York to consult with Mr. Roebling. Their surprise was great when Mrs. Roebling sat down with them, and by her knowledge of engineering helped them out with their patterns, and cleared away difficulties that had for weeks been puzzling their brains. Among the gentlemen who have had occasion in the course of business at various times to test Mrs. Roebling's engineering skill, is Frederick J. Slade, treasurer of the New Jersey Steel and Iron Company, Trenton. Mrs. Roebling is a sister of the late Gen. G. K. Warren, of the U.S. Engineer Corps, U.S. Navy, and belongs by birth to a great engineering family, whose name is honoured and respected wherever known.—*Nautical Gazette*..

TRIAL TRIP OF A HULL STEAMER.—On the 11th inst. the steamship Bass Rock, built by Mr. D. P. Garbutt, of Hull, went on her trial trip, starting from the Albert Dock, and going as far as Dimlington and back. The Bass Rock has a length of 340ft. and a breadth of 42ft., and 28ft. 3in. in depth of hold, thus being one of the largest and finest vessels ever built in Hull. She was constructed under special survey, to class 100 A1 at Lloyd's, and also under the special survey of the Board of Trade, and will have the passenger certificate of the latter. She has an extra number of transverse bulkheads, and several parts of the ship exceed in strength the requirements of Lloyd's and the Board of Trade. Special arrangements have been made to adapt her for the carriage of troops, horses, or cattle. Her dead weight capacity is about 5000 tons, and her measurement nearly 7000 tons. The numerous fittings include steam steering gear, one of Harfield's patent windlasses, and five steam winches, supplied by Messrs. Good and Menzies, Hull. There have also been furnished two fresh water condensers, capable of producing 2000 gallons of water every twenty-four hours. The Bass Rock is propelled by a pair of compound inverted direct-acting engines. The diameter of the cylinders is 44in. and 84in. respectively, with 54in. length of stroke. She is fitted with two double-ended steel boilers, 14ft. 9in. in diameter and 18ft. long. Steam is supplied at a working pressure of 80 lb. per square inch. The heating surface is 7520 square feet, and the cooling surface 4520 square feet. The diameter of the propeller is 17ft. 6in., and 23ft. 6in. pitch, and is fitted with four movable blades. The trial trip was most satisfactory to every one concerned. The weather was exceedingly favourable. At 58 revolutions and 27½in. vacuum, and 77 lb. of steam, she attained a speed of 13 knots, the indicated horse-power being 1980. This was, of course, with the vessel light, and it is expected that when the propeller is more submerged, and freer action is attained by the engines, still better results will ensue. There was a large company on board, including Mr. D. P. Garbutt, Mr. W. Garbutt, Mr. Preston, Mr. Spear, Board of Trade surveyor; Mr. Stevens, Lloyd's surveyor; Mr. Gemmell, shipyard manager, &c. The vessel was in command of Captain Thompson, and the engines, &c., in charge of Mr. Key, the manager of the engine works.

RAILWAY MATTERS.

THE Victoria railway receipts for the year ending June 30th will amount to very nearly £2,000,000.

THE Madras Railway Company has decided to use the electric light along its lines, and has ordered the necessary apparatus from England.

THE Barbadoes Council recently rejected the proposed Railway Bill, much to the annoyance of the Colonists, who desire that the Company should be liberally aided and supported.

THE death occurred at Darlington last week of John Barnett, the first railway porter ever employed in passenger traffic. Barnett accompanied the old No. 1 engine on its trial trip with George Stephenson.

THE rush of settlers for the Island railway lands in British Columbia is tremendous, and, the *Colonies and India* says, before the exact route has been determined many Canadians are settling on the supposed line of the railway.

THE rate for coal from Yorkshire by railway is from 3s. 8d. to 3s. 9d. per ton per 100 miles. On the other hand, the charge for coal going from the North of England to the Thames in screw steamers is not more than 1s. 8d. per ton per 100 miles.

A RAILWAY being projected into the interior, British Honduras will be able to export larger quantities than ever of the mahogany, cedar, ebony, india-rubber, and other products with which she abounds, and of which this country can easily absorb large quantities.

THE tonnage of coal from Yorkshire carried by the various lines to London during last month was as follows:—Midland, 169,739; London and North-Western, 129,310; Great Western, 100,233; Great Northern, 95,492; Great Eastern, 55,376; other lines, 6753; total, 556,909 tons. In March the total was 585,726 tons, and in April 581,533 tons.

THE offer of Messrs. Morton, Rose, and Co. for the construction of the Chanda-Hyderabad Railway, which has recently been the cause, the *Colonies and India* says, of so much misrepresentation and consequent excitement, has been accepted; and now that the Council of Regency has made public the conditions affecting the scheme, we shall probably hear of no further opposition to it.

THE statement about the falling in of a portion of the tunnel of Ripanje, on the Belgrade-Nisch Railway, is now positively contradicted from Belgrade; not a stone has moved. Only a few days ago the Minister of Public Works visited the tunnel, which is progressing rapidly, and found everything in the best order. The *Times* Vienna correspondent says the Director of Railways has lodged a complaint against the two newspapers for spreading false news.

THE Drachenfels Railway, which was commenced last November, has, according to the *Cologne Gazette*, made such progress that its opening for traffic in July is confidently expected. Its course is partly straight and partly curved. In a total length of about 1700 yards there is an ascent of about 250 yards to be overcome, the gradients varying from 1 in 10 to 1 in 5. The final portion of the work has been specially difficult, involving the construction of two viaducts at a portion of the line where there is a gradient of 1 in 5½. It is intended to keep the locomotive always below the level of the train, and the carriages will not be fastened together, so that in case of necessity each carriage can be brought to a standstill by the brakes which are provided. The general arrangements of the railway are said to correspond with those of the Rigi line.

SOME of the inhabitants of Kidderminster are afraid that the wooden viaduct on the Great Western Railway which crosses the Hoo Brook about a mile to the south of Kidderminster station has become unsafe consequent upon its age, and on Monday the Mayor, after receiving a report from the borough engineer, telegraphed to the railway authorities on the subject. In reply an engineer of the company has visited the place and made a careful inspection. It is understood that he still regards the structure as safe, but it is likely that the Board of Trade will be asked to also send down an inspector at an early date. The viaduct is a quarter of a mile long and was opened in 1852. It is believed that last year the Great Western Board entered into a contract to replace the present structure with a permanent brick viaduct, but that owing to a difficulty about acquiring land it has not yet been carried out.

IN concluding a report on the collision that occurred on the 15th May between two return special excursion trains, one belonging to the Great Northern Railway Company on its way back from Cleethorpes and Grimsby to Nottingham *viâ* Boston, and the other belonging to the Midland Railway Company, but worked by the Manchester, Sheffield, and Lincolnshire Company's engine, on its way back to Leicester *viâ* Lincoln, Colonel Yolland says:—"In all probability the collision would not have occurred at all if the continuous brakes on the Midland train had been available for arresting its progress; and it is, in my opinion, to be regretted that engine drivers are not prohibited by law from taking on foreign trains on the lines on which they work unless their engines are so fitted as to be enabled to be properly connected with and to make use of the continuous brakes fitted on these foreign trains, in order to pull them up, when required, in a short interval of space. It is very fortunate that the collision was not, at once, attended with far more serious results."

THE Bills promoted by the Commissioners of Sewers and the Metropolitan Board of Works for the purpose of authorising the removal of the District Railway ventilators came before a Select Committee of the House of Commons yesterday morning—Mr. Stansfeld in the chair. Mr. Littler, Q.C., Mr. Collins, Q.C., and Mr. Rigg were counsel for the Commissioners of Sewers; Mr. Saunders, Q.C., Mr. O'Hara, and Mr. Freeman were for the Metropolitan Board of Works; Mr. Pope, Q.C., Mr. Bidder, Q.C., Mr. Pollock, and Mr. E. F. Lankester were for the District Railway Company; and Mr. Worsley Taylor watched the case for the Metropolitan Railway Company. Mr. Littler, Q.C., opened the case for the Commissioners of Sewers. Having stated how the ventilators came to be constructed, he called attention to the ventilator in Queen Victoria-street, and said that it was a very serious obstruction. The ventilator there was a source of very great danger to foot passengers. The foul air coming through the ventilators was a source of great annoyance. Colonel W. Heywood, engineer to the Commissioners of Sewers of the City, said the roads and pavements were under his management. He had paid considerable attention to the question of City traffic, and had given evidence against the ventilators before both Houses of Parliament.

THE report of the Great Indian Peninsula Railway Company for the half-year ended 31st December last, states that the mileage for that period was 1446, against the same figures in 1881, and 1292 in 1880. The passenger receipts were £850,135, against £256,616 and £281,064 in the two previous years. The goods traffic was £862,965, against £1,014,177 and £659,960, and the miscellaneous receipts £19,379, against £18,515 and £21,427 for the corresponding periods of the two previous years. Compared with 1881 there is a reduction of £75,744 in the net receipts of the half-year. The traffic of 1881 was, however, exceptionally good, short grain crops in America and Europe, and consequent active markets, having influenced an unusually large export of wheat from India, where harvests had been abundant. The present grain rates on this railway are on the average not more than 6 pies, or ·625d., per ton per mile, which is exceedingly low, and much within the maximum sanctioned by Government. The directors have represented to the Secretary of State for India, in reply to a letter from him on the subject, that while any possible reduction in the rates for carriage of wheat would not have any inappreciable effect in promoting export to European markets, it would seriously affect the revenue of the company, and that, therefore, they are unable to entertain the question of reduction at present.

NOTES AND MEMORANDA.

THE rainfall at Greenwich in 1882 was 25·2in., being very slightly above the average.

DURING the year 1882 there was no case of failure in the automatic drop of the Greenwich time-ball. On three days the ball was not raised on account of the violence of the wind.

THE number of hours of bright sunshine recorded by Campbell's sunshine instrument at the Greenwich Observatory during 1882 was 1245, which is more than forty hours above the average of the five preceding years.

IN a laboratory note recently read before the Chemical Society by Messrs. Gladstone and Tribe, on "A residual Phenomenon of the Electrolysis of Oil of Vitriol," the authors say it was noticed that gas continued to be evolved from both the electrodes after the battery had been disconnected. This gas was oxygen. This phenomenon is probably due to the presence of Berthelot's persulphuric acid.

ON the reducing action of spongy lead Messrs. Gladstone and Tribe say:—Spongy lead, free from occluded hydrogen, reduces nitrates to nitrite, ammonia being simultaneously formed. This spongy lead has no action upon an aqueous solution of potassium chlorate, but the addition of 1 per cent. sulphuric acid causes a slow reduction to chloride. Lead filings cause similar reductions, but their activity is much less.

A COMPOSITION has been invented by Messrs. Dankworth and Landers, of St. Petersburg, which is said to be elastic, tough, waterproof, and insulating, and applicable to nearly all the purposes for which india-rubber is used. It is composed of a mixture of wood and coal tar, linseed oil, ozokerit, spermaceti, and sulphur, which are thoroughly mixed and heated for a long time, in large vessels, by means of superheated steam.

M. E. BOUTY has found by recent observations that the variations of volume in galvanic deposits, which exercise a pressure upon the moulds, and the Peltier phenomenon at the surfaces of contact, are mutually connected. He finds a certain intensity of current, which he calls the neutral point of temperature. In all higher intensities the electrode heats, and in lower intensities it cools, during the process of deposition.

THE Deal time-ball, in connection with Greenwich, was dropped automatically at one o'clock on every day throughout the year 1882, with the exception of five days on which there was failure in the telegraphic connection, of one day when the ball was accidentally dropped 4 sec. too soon by telegraph signals, and of fourteen days when the current was weak and the trigger was released by the attendant without appreciable loss of accuracy. On twelve days the ball was not raised on account of the violence of the wind.

THE thermo-electric batteries—and especially those of M. Clamond—had raised large expectations, because the corrosion of the solderings was attributed to heat alone, and it was hoped that it might be remedied. The "Journal" of the Franklin Institute says that Exner has just shown that it is due to oxidation by the air aided by the heat, and that if this action were prevented—by the use of nitrogen, for example—the electric current would not be formed. Thermo-electric batteries are, therefore, simply gas batteries, in which certain gaseous fluids act in a similar manner to acid liquids.

THE following analyses by Schwartz tend to show that American barley is richer in starch, and therefore in extract, than European barley:—Moisture, 13·71; starch, 66·05; albumenoids, 11·41; ash, 3·23; phosphoric acid, 0·953. The percentages of starch, albumenoids, ash and phosphoric acid are calculated on the perfectly dry barleys. The following comparative analyses of American and European barleys by the same authority have been given by the *Brewers' Guardian*:—Moisture, American, 13·71; European, 15·11. Starch, American, 66·05; European, 64·14. Albumenoids, American, 11·41; European, 11·21. Ash, American, 3·23; European, nil, Phosphoric acid, American, 0·953; European, 0·995.

IN the magnetic observation department of the Greenwich Observatory earth currents in two directions nearly at right angles to each other are photographically registered, and the Astronomer Royal in his recent report says:—"A great improvement has been made in the photographic registration by the substitution of Morgan and Kidd's argentic-gelatino-bromide paper with ferrous oxalate development for the old photographic process. The greatly increased sensitiveness of the new photographic paper allows of a great reduction in the effective surface of the concave mirrors carried by the magnets and in the size of the gas flames." Greater sharpness in the photographic trace is secured without trouble from discoloration. The saving in gas and in computers' time probably makes up for the increased cost of the paper, which is rather expensive.

SWEDISH engineers have noticed that the quantity of phosphorus in the pig manufactured with charcoal is larger than that in the ore and fluxes, even assuming that all of it had gone into the pig. Jansen found that, when he melted ores in crucibles, the metal obtained ran lower in phosphorus than the pig obtained from the same ores. Sarnstrom, in 1881, made some analyses of charcoal, the results of which seem to lead to the conclusion that the excess is due to that fuel. Two general samples were taken, No. 1 containing 6·8 per cent. of water and No. 2 5·0 per cent. Of both, 4 lb. of undried material were burned, yielding 1·02 and 0·88 per cent. of ash respectively. The former contained 1·64 and the latter 0·65 per cent. of phosphorus, so that charcoal No. 1 had 0·0167, and 2 0·0054 per cent. of phosphorus; and assuming that the quantity of fuel used is about equal to the weight of pig produced, it will be seen that the charcoal carries about the above quantities of phosphorus into the cinder.

KIRCHHOFF and Bunsen have shown that the temperature of the flame in which a metal is reduced to vapour has no influence upon the position of the brilliant lines in its spectrum. When the temperature is raised, fine new lines usually appear, but those which were shown at lower temperatures still remain. This, says the "Journal" of the Franklin Institute, is not the case, however, with metalloids. Plücker has shown that they give two different spectra, according as the tubes are heated by the ordinary spark or by that of the Leyden jar. Von Monckhoven has found, by numerous experiments, that it is possible to produce the spectra which have usually been attributed to high temperature at very low temperatures, and *vice versâ*. By a critical experiment he was able to produce the two spectra superposed, so that, according to Plücker's hypothesis, the gas should have had at the same instant two different temperatures, which is of course, inadmissible. He attributes the change of spectra to a special vibratory state of the molecules, directly dependent upon the nature of the electricity employed.

PURE nickel, after melting and casting, generally holds a greater or less quantity of oxygen in combination, and the metal is brittle. To hinder the injurious effects of the oxygen, it is necessary to incorporate in the melted nickel some substance which has a strong affinity for oxygen, and also for the nickel itself. According to the "Comptes Rendus," M. J. Garnier finds that phosphorus serves both of these purposes very satisfactorily, producing effects analogous to those of carbon in iron. If the phosphorus does not exceed three-tenths of one per cent., the nickel is soft and very malleable; above this quantity the hardness increases at the expense of the malleability. Phosphorised nickel, when alloyed with copper, zinc, or iron, gives results which are far superior to those that are obtained from the same nickel when not phosphorised. By means of the phosphorus Garnier has been able to alloy nickel and iron in all proportions, and always to obtain soft and malleable products. The contradictions of illustrious chemists are thus explained, some saying that such alloys were brittle, others that they were malleable. The latter had alloyed the nickel to phosphorised iron.

MISCELLANEA.

THE name of the Anglo-Austrian Brush Electrical Company, Limited, has been changed to the International Electric Company, Limited.

THE Joint Committee of the Lords and Commons on the subject of the proposed Channel Tunnel yesterday took the evidence of Lord Wolseley.

A REPORT of Sir John Hawkshaw's Committee on the works required for repairing the Madras breakwater has recommended alterations and improvements which will involve a further expenditure of £480,000.

PROPOSALS for the erection of the electric light tower on Blackwell's Island, U.S., will be issued shortly. The plans are said to be for a skeleton tower 255ft. in height, 54ft. at the base, and 6ft. at the top, to carry six electric lights of 2000-candle power each.

THE foundation stone of the new Roath Dock, which is being built at Cardiff by Lord Bute at a cost of half a million, was laid yesterday by Mr. W. T. Lewis, general agent to his lordship. The water area of the dock will be 35 acres. The work will occupy several years.

AT a German ultramarine manufactory the director has observed that for forty-four years none of his workmen have ever suffered from consumption. He attributes their immunity to the fact that the process of manufacture involves the constant production of sulphurous acid, by the burning of sulphur.

THIS year's exhibition of the Worcestershire Agricultural Society, which opened on Tuesday at Battenhall, near Worcester, on a space of eighteen acres, drew together a larger collection of implements and machinery than any previous show of the society. Many of the chief implement engineering firms were represented.

THE death is announced from South Australia of Mr. Robert George Thomas, civil engineer, and secretary to the Central Board of Health. From the same colony it is announced that Mr. Jones, Deputy Surveyor-General, has made a rough statement, according to which the cost of the suggested canal to connect Lake Eyre with the sea would exceed £37,000,000.

THE fitters, turners, and smiths employed in the engineering establishments at Sunderland, numbering about 1000, came out on strike yesterday morning. They seek an advance of 2s. per week, and limitation of the number of apprentices to two apprentices for every five men employed. The employers are willing to give an advance, but not to lessen the number of apprentices.

THE area now available for the largest class of steamships in the Colombo harbour is considerable, and moorings are now being laid capable of securing twenty-four steamships drawing 25ft. of water. The proper completion of the dredging operations will, we learn, not be attained before December of next year. The preparation of the concrete blocks for the pier head and landing jetty is being vigorously proceeded with.

THE s.s. Italia, which has been built and recently launched at the Deptford Shipbuilding Yard, went her trial trip on the Thames on June 11th, over the measured mile at Erith. Successive runs were made, and a mean speed of 11 knots per hour was obtained. The engines, which are by Messrs. Gourley Bros., with cylinders of 21in. and 42in. diameter, and a stroke of 30in., developed 400 indicated horse-power, with 80 lb. boiler pressure, and worked extremely well throughout the trial; they, as well as the ship, have been superintended during construction by Mr. J. F. Flannery, London, on behalf of the Union Steamship Company, of Portugal.

DURING the course of a discussion on artificial fuel before the Hanover Section of the German Society of Engineers, it was stated that experiments made by Herr F. Fischer with lignite containing 60 per cent. of water and having a calorific value, when coming from the mine, of from 1000 to 1500, have when dry from 3000 to 3500. He found, after a series of trials with an experimental plant, that the best temperature for coking lignite with the aid of steam was 450 deg. Celsius, obtaining thereby 32 per cent. of the weight of the moist lignite in the form of coke, holding from 6 to 7 per cent. of ash, and having a calorific value of 7500, equal to a fair bituminous coal.

PROFESSOR BOCK, of the Leoben School of Mines, has devised a testing machine, in which the sample is inserted vertically, its upper end being attached to a cross-beam in connection with a strong screw. This screw is made to rise by causing the nut to revolve by means of spur gear, in such a manner as to exert a tensile strain on the sample. The lower end of the sample is also attached to a cross-beam, which transmits the strain to the short arms of a steel-yard, the long arm of which is connected, by a vertical rod or link, to a second steel-yard placed above the first. A weight is made to slide along the long arm of the second steel-yard, thus counter-balancing a pre-determined strain exerted on the sample. The machine is also provided with means for measuring torsional and shearing strain as well as that of tension.

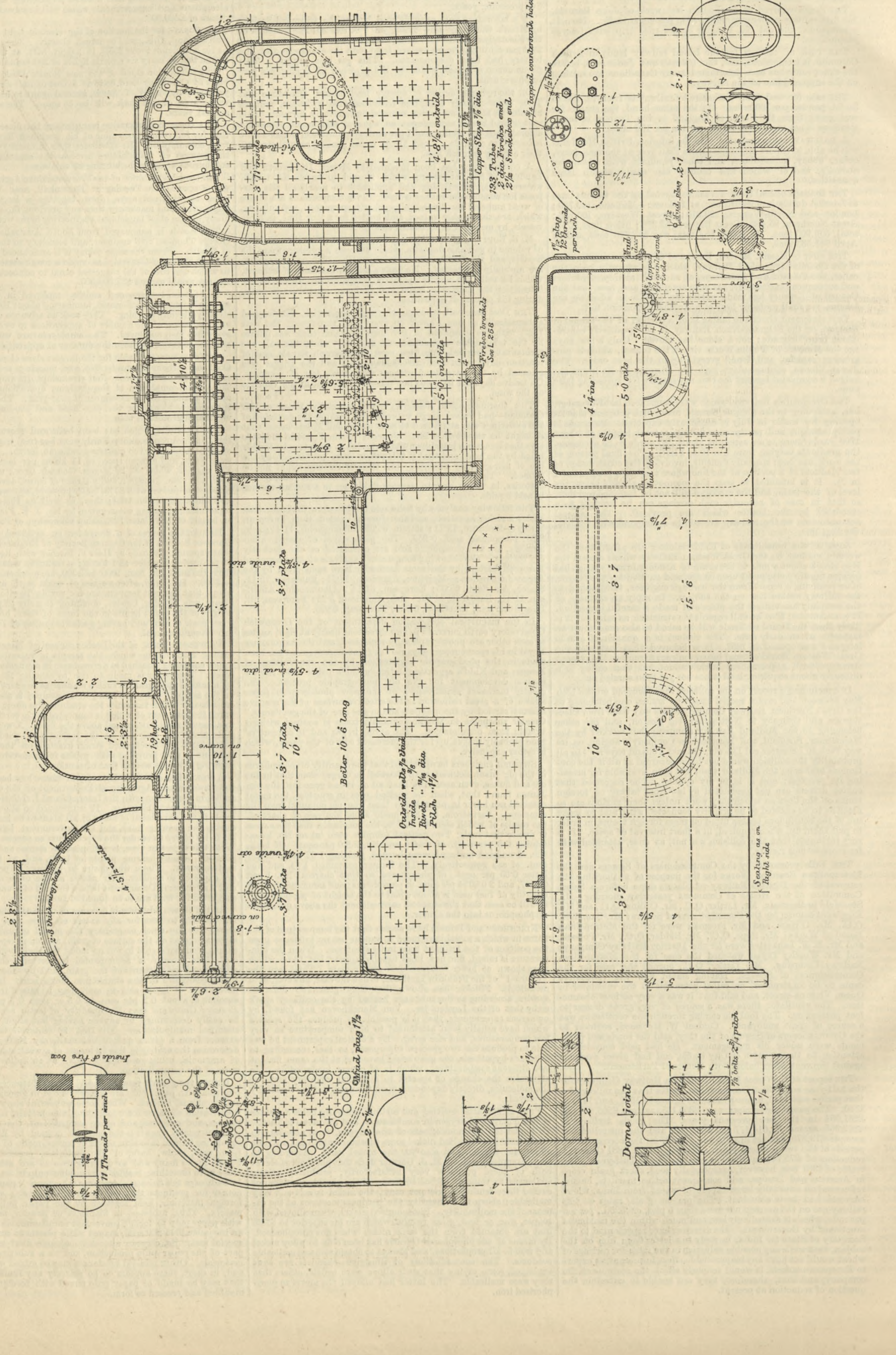
A NEW scheme for the discovery of fibres has been proposed by the Revenue and Agricultural Department of the Government of India, in connection with the International Exhibition to be opened at Calcutta next December. It is intended to allow experimental trials in the extraction of fibres of all kinds to be made at Calcutta during the ensuing rains, and the Government has decided to do all in its power to render the experiments as successful as possible. With this object in view, it will provide stems and other fibrous portions of fibre-bearing plants or trees, and, as far as possible, motive power. Those who desire to perform experimental trials are expected to register their names at the office of the Revenue and Agricultural Department before the end of June. The plants suggested for trial are to be found in India.

AS the season advances it becomes of more and more importance for brewers to test for any excess of lactic acid in malt. By storage in the stack or granary the mould organisms which are always present on the surface of grain, and more especially on such as has been harvested in wet or moist weather, begin to develope, and their growth is accompanied by certain changes in the albumenoid constituents of the grain, and by the conversion of small quantities of the starch into lactic acid. In this way the percentage of lactic acid in malt may be raised from its normal amount of about 0·2 per cent. to 0·5 or even 0·7 per cent. The *Brewers' Guardian* says the quantity of lactic acid in malt may be easily determined by anyone having but slight experience in chemical manipulation. All that is required is to make an extract from a given quantity of malt, say 1000 grains, and to determine the acidity in this by means of a weak standard solution of ammonia, using good litmus paper as an indicator of the progress of the neutralisation.

UNDER the generic term of paper, other substances used in combination with paper pulp are comprehended in general descriptions and occasional notices. When some wonderful story is read of the substitution of paper for wood, stone, the metals, for mortar, and plaster, and concrete, and other compositions, the reader should not understand that it is the material defined by Webster as "a substance formed into thin sheets or leaves, made of pulp obtained from rags, straw, bark, or like materials, pressed and dried." Paper, for so many and so differing uses as are attributed to it, must have something besides a vegetable pulp in its composition. In fact, says the *Scientific American*, the term "paper" is a misnomer for products that derive all their special qualities from foreign materials, held together by the paper pulp acting as a matrix. Thus, asbestos, in filaments or powder, may be mixed with paper pulp to form a convenient uninflammable and possibly an incombustible material, shaped while plastic to convenience for special uses. So, clays in almost impalpable dust may become a part of the paper pulp production, and be a substitute for other materials. Other mineral substances may be mixed with the pulp, and, in short, there appears to be scarcely any limit to the uses that may be made of paper pulp mixed with foreign substances, moulded and pressed to form.

CONTRACTS OPEN—LOCOMOTIVE BOILERS FOR THE BOMBAY AND BARODA RAILWAY.

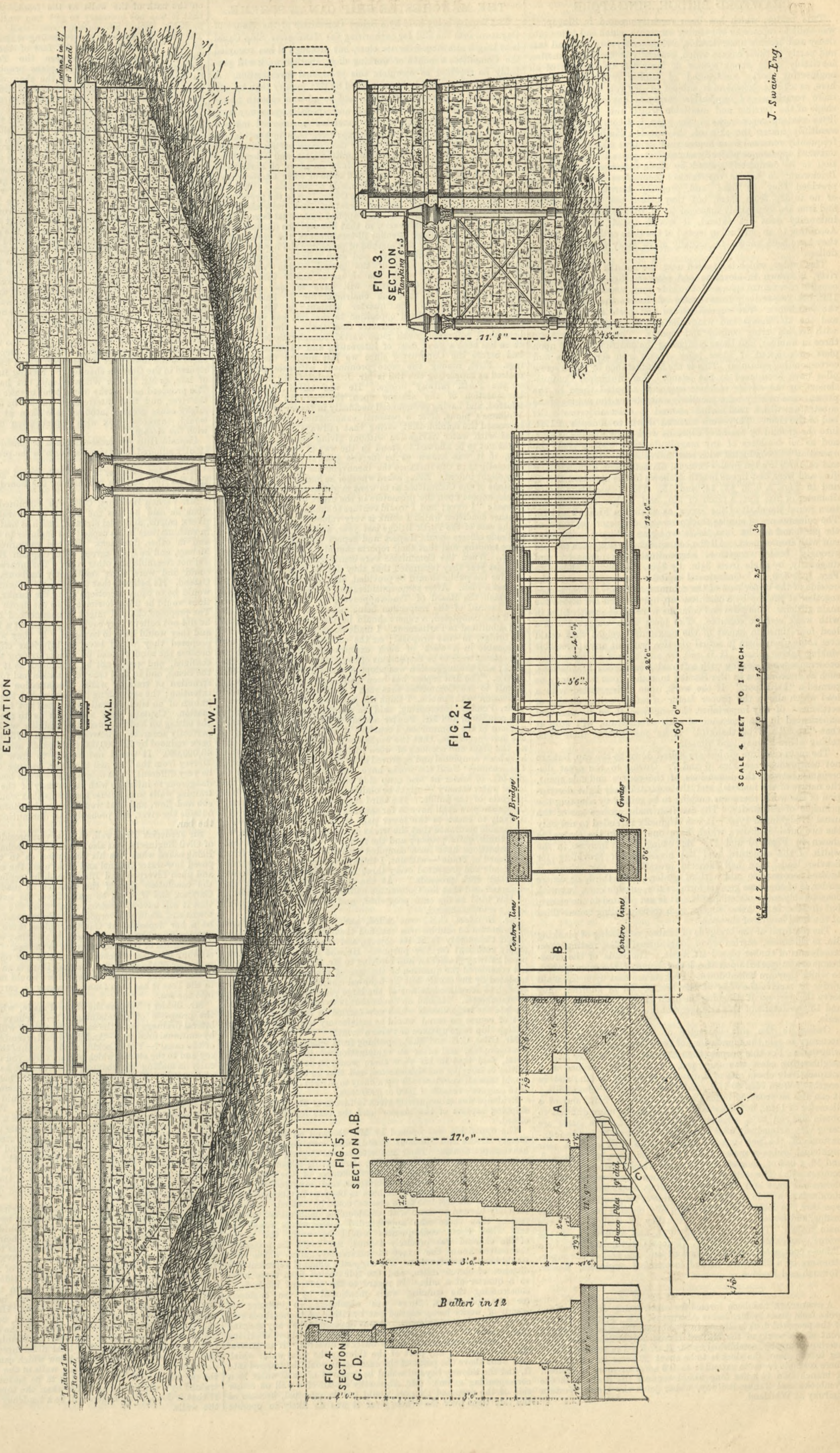
(For description see page 480.)



CRAWFORD BRIDGE, SINGAPORE.

MR. THOS. CARGILL, M.I.C.E., ENGINEER.

(For description see page 472.)



CRAWFORD BRIDGE, SINGAPORE.

THIS bridge, which has been recently erected in Singapore, was built to replace an old timber structure which had fallen into decay and become unserviceable, owing partly to wear and tear and partly to those causes which, especially in tropical countries, inevitably bring about sooner or later the destruction of all engineering works constructed of similar materials. Timber here, as well as elsewhere, is subject to dry rot, but it has a far more voracious and implacable enemy to contend with in the shape of the terrible and insatiable white ant. This insidious little creature never works in the open, but commits its ravages stealthily under the skin of the wood. Timbers have been frequently removed from houses and bridges which were to all outward appearance perfectly sound, but proved upon examination to be completely gutted by their insectile depredations. Brickwork, so far as the bricks themselves are concerned, provided they be hard and properly burnt, suffers little or no injury from them, but they attack the mortar. Stone and iron are fortunately inaccessible to their assaults, but this immunity does not extend, it would appear, to all metals. According to an old Indian legend of the time of the "Company," they have been known to actually make away with hard silver dollars.

This bridge, which is situated near the mouth of the Rochore river, is shown in elevation and plan in Figs. 1 and 2, and consists of a centre span and two side ones, measuring 44ft. and 12ft. 6in. respectively from centre of piers to the bearings upon the abutments. The superstructure and piers are of cast iron, and the abutments and wingwalls of rubble granite masonry, with dressed string courses and copings. The main girders are three in number, and those composing the centre span rest upon piers constructed of three pairs of cast iron screw piles and corresponding columns. This is the first instance in which screw piles have been used in the island. The Municipal Commissioners, by the advice of their engineer, adopted them in the present case as they were peculiarly suitable for the nature of the substratum which trial borings showed to exist underneath the bed of the river. They were screwed down to a depth of 19ft. into the ground by means of capstans worked by manual labour, and as no boulders of any magnitude were encountered, the operation was conducted with ease and celerity. The screw piles and columns are ten inches external diameter with a thickness of ⅞in., and were cast in one length as shown in the elevation Fig. 1, and in Figs. 3, 6, 9, 13, 14, and 15. The screw blade has a diameter of 2ft. 6in., a pitch of 5in., and makes one complete turn round the shaft of the screw as shown in Figs. 12 and 13. The columns are of similar thickness and diameter to those of the piles, and are let into the latter by an ordinary socket joint run with iron cement. All the columns comprising each pier are strongly braced together longitudinally, transversely, and diagonally, by angle irons 3½in. by 3½in. by ½in., as shown in Figs. 1, 2, 3, 9, 13. Ornamental capitals are tapped on to the outside of the upper part of the columns, and they are connected together at the top by a cast iron cap, upon which are bolted the main girders. The piles and columns were subsequently filled in with weak cement concrete. The piers were weighted with a load four times in excess of the maximum weight that could ever come upon them in actual practice, without any appreciable sinking taking place. It is not by any means an uncommon occurrence when dealing with soft and treacherous foundations, such as are common in the Straits, to come upon what may be termed a "hard spot." If the work, upon being tested with a load which allows the proper factor of safety, evince no sign of settlement of any importance, the engineer, if he be wise and experienced in the character of such substratum, will stop at that "spot" and be thankful. If he goes farther there is no telling where he may land himself.

The main cast iron girders are bolted down to the cap, but are not continuous—see Figs. 6 and 7. Owing to the great discrepancy between the dimensions of the centre and side spans, the nature of the material, and the comparatively light description of the work, there was nothing to be gained by adopting the principle of continuity. The cast iron main girders are of the usual Hodgkinson type. It was originally intended to use only the two outside girders, which have one joint in the centre, as shown in Figs. 16 and 17. But owing to an increase in the width of the structure, and the necessity for providing for heavier loads than had hitherto prevailed in the colony, it became necessary to add a third girder. This third, or centre girder, is of the same general form as the outside ones, but with considerably more material in it. It is not jointed in the centre, but divided into three lengths, each corresponding to one-third of the total length of the span.

The platform of the bridge is of timber, consisting of planking 3in. in thickness, carried upon longitudinal balks, resting upon crossbeams of timber placed 4ft. apart. The ends of the crossbeams are supported upon the lower flange of the main girders, to which they are bolted down. Pockets are cast upon the main girder to receive the ends of the beams, and in addition they serve the purpose of stiffening the main girders. In Figs. 16, 17, and 18 the details of this arrangement are shown to an enlarged scale.

Owing to the soft character of the substratum it was necessary to pile the foundations of both the abutments and the wingwalls. For this purpose the common round timber of the neighbouring coast was employed. It is really obtained at a comparatively cheap rate of a diameter from 5in. to 6in., and in lengths of from 15ft. to 17ft., and makes excellent close piling. It can also be procured in lengths from 20ft. to 25ft., and of a diameter of 11in., but these large scantlings are more difficult to obtain and run to a considerably higher price. The latter are being very extensively used in Singapore, at present, in the foundations of the new magistrates' court, as well as in a new municipal bridge over the canal. Upon the piles, see Figs. 4, 5, and 16, a bed of concrete is laid, upon which the stonework is commenced. The sections of the abutments and wingwalls are shown in Figs. 4 and 5. The hand railing consists of cast iron standards of a plain pattern and a couple of longitudinal wrought iron bars. A facia board runs the whole outside length of the bridge, and serves to mark the inequality in the depth of the main girders. The piling, foundations, and stonework of the bridge were executed under Mr. Thomas Cargill, M.I.C.E., by a Chinese contractor, and the ironwork and the rest of the superstructure by a Singapore firm of mechanical engineers, Messrs. Howarth and Erskine.

A SYNDICATE has been formed for constructing docks at Pembroke from plans by Mr. James Abernethy, C.E., F.R.S. The site of the proposed dock is situate in Pembroke River, and almost in front of the works of the Milford Haven Shipbuilding and Engineering Company, established by Sir E. J. Reed in 1874. According to the plans, the dock is to be about 20 acres in extent, and there is ample room to extend it to 100 acres or more if desired. A branch line 1½ miles long would connect the docks with the Pembroke and Tenby Railway, which joins the Great Western Railway at Whitland.

THE MANCHESTER SHIP CANAL SCHEME.

THE inquiry being held by a Select Committee of the House of Commons into the Bill for authorising the Manchester Ship Canal is at length drawing near its close, but although it has occupied the Committee a month of working days, another week will probably be required to complete this protracted investigation. A wider field has probably been covered by this inquiry than by any ever before held at Westminster, and to all who concern themselves with questions of engineering, and especially water-way engineering possibilities, and in the extensive commercial matters affected by this project, the proceedings have been in the highest degree interesting. From day to day the various parties interested in the scheme have crowded the Committee-room, and followed the inquiry with surprising patience. Many members of Parliament have attended from time to time, and some of their number have been examined as witnesses on one side or the other. The disciplinary treatment meted out by the Committee to the promoters, in order to prevent useless iteration and reiteration of evidence and argument, has been applied with equal fairness and partiality to all the petitioners, so that however the decision goes, neither side can allege peculiar ill-treatment in the presentation of their case. But for this method of procedure the inquiry would have lasted very much longer, and even now its duration is a serious matter in view of the period within which the Bill, if passed, can reach the House of Lords this session. Even as it is the Committee will have to lose two days next week in order that the chairman, Sir J. Bailey, may fulfil his duties at the quarter sessions in his county. The case of the combined opposition to the Bill has necessarily been of a less technical character than that of the promoters, because it embraced much more varied considerations, but yet there has been a good deal of interesting and valuable evidence laid before the Committee since we last noticed the proceedings. First, among the more prominent witnesses still to be noticed as supporting the Bill is Mr. J. Fowler, C.E., the engineer of the Forth railway bridge. He was called mainly upon the question of the scheme upon the railways likely to be affected, and having pronounced decidedly in favour of Mr. Leader Williams's plans, after a personal examination of the spot, he expressed the opinion that, seeing that railways had often interfered with water navigation without giving compensation, they ought not to be allowed to stand in the way of such a scheme as this, if it was shown to be for the general public good, more especially as in this instance the inconvenience to them would be very slight indeed. Being asked whether he had considered the suggestions of the Committee as to what might be the conditions they would impose upon the promoters in the event of the Bill passing, he said: "I have; and I would venture to submit to the Committee another condition which I think is very valuable. It was adopted in the case of the Forth Bridge last year, and it is that the Board of Trade officers should inspect and report upon the works every three months, and that their reports should be laid before Parliament. When the Committee were considering the Forth Bridge Bill last year they intimated that they desired that special protection for the public should be provided, and asked the promoters to suggest a plan. After some consideration a scheme was submitted of which the Board of Trade approved, the effect of which was that instead of the inspection being postponed until the whole work was completed, a report should be made every three months and submitted to Parliament. I made no objection, as engineer of the bridge, to that proposal; on the contrary, I thought it only reasonable in a work of such exceptional importance. These inspections were to be inspections of everything connected with the work; and the suggestion was adopted with the approval of all the parties. The first report has been made, and I would respectfully submit to the Committee that such a condition would be a great protection to the public. I think the promoters would assent to it."

Mr. Pember, interposing, said he should have no objection to this condition, and Mr. Fowler added: "With regard to the suggestions of the Committee, I consider it quite proper, according to the first suggestion, that the works should not be carried out until all the plans and sections of work within their jurisdiction should have been completed and approved of by the Mersey Commissioners. The second—'Until the works have been so far completed as to give 9ft. of water at low neap tide continuously throughout the lower water estuary'—might be omitted. That is entirely in the interests of the public. The third suggestion—'Until the Mersey Commissioners shall have so far satisfied themselves that no injury is likely to ensue to the lower part of the estuary as to give a reasonable assurance that the works can be permitted to remain'—is, I think, quite proper; and the fourth—'Until certificates that the conditions have been complied with have been obtained from the Board of Trade'—will not, I think, be necessary; for if reports are made and presented every three months, everybody will know how the work proceeds." At the close of this statement, the chairman said that the Committee had been considering something of this kind as the case proceeded, and Mr. Fowler having been briefly cross-examined,

Mr. Brunlees, C.E., was called, and in the course of a short examination he said he was satisfied that the scheme as proposed would thoroughly fulfil its objects, and that the estimates were amply sufficient for the purpose. He also approved of the proposed railway gradients, and replying to Mr. Bidder, he said he had not considered the question of the size of the vessels to be accommodated by the canal, but he believed the canal would be wide enough to accommodate any of the large vessels expected to go up to Manchester. He had no doubt that it would be able to accommodate the large vessels which now carried on the Liverpool trade, but of course no canal would be satisfactory which only allowed a large ship to go up once or twice a month.

Mr. Giles, C.E. and M.P., speaking from practical experience at Southampton, and after an examination of the course of this canal, said that in his view there would be no engineering difficulties in carrying out this scheme, and that he believed the canal would take all vessels which were likely to go right on to Manchester with cargoes—vessels of 2000 or 3000 tons.

Evidence was subsequently given in favour of the Bill upon the shipping aspects of the matter and the case for the promoters closed.

The opposition was opened by Mr. Rodwell on behalf of the Mersey Docks and Harbour Board, who were described as the heaviest petitioners. Their first witness was Captain Hills, R.N., marine surveyor to the Board, who, after giving elaborate details respecting the conditions and circumstances of the Mersey in respect to tides and other considerations, said he agreed with Mr. Bateman that some time would have to be spent in taking observations before the best line for a channel could be decided. It would certainly have to be done with considerable deliberation, for this reason, that those who apprehended consequences could not tell what those consequences would be until the course of the channel was precisely defined, nor could the promoters themselves know the exact circumstances under which they would have to construct it. The suggested channel represented a distance of eleven miles, and the tide varied from three miles to a quarter of a mile. In regard to the different methods of constructing the training walls mentioned by the engineers for the promoters, there was absolutely no instance on record of works being carried out by either of the methods proposed in any known tideway. It was impossible that any training walls could divert the water into a channel without depriving other parts of the tideway of the water so diverted. If an excavation were made in any part of the tideway the tidal water which now went above the point of the excavation would be trapped into it, and the tideway beyond would be deprived of tidal water to a corresponding extent. Mr. Abernethy's plan of a wall on either side of the proposed channel would not be effectual, because as the tide went over the whole river it was as likely to operate on the back of the walls as the front. Mr. Fowler suggested that it was not necessary to put two walls, but that he would probably begin by putting one wall on the south side. That was the measure of proceeding which had been followed in the Tees, but beyond the fact of their being tidal rivers, there was no analogy between the Tees and the Mersey. Assuming that either one of the plans proposed might eventually be made successfully so far as the channel was made, other portions of the tideway must be deprived of tide to such an extent as was required to fill up the vacancy. The consequence would be that a new margin would be set up for the tideway, and that on that margin silting up would occur as the tide came in. The silt held in suspension was something very considerable. From examinations which he had made some time ago at Seacombe Narrows, he had ascertained that every cubic yard of water going out of the river took with it nearly a third of a pound of silt, while the quantity of silt brought into the river was about one-thousandth part of a pound per cubic yard less; but in a gale of wind from the north-west as much as 2½ lb. of silt would come in with every cubic yard of water. There was no instance of a channel being trained in the way proposed by the promoters, which had not led to land reclamation and to loss of tidal area, and the analogy which the promoters had made between the proposed works in the Mersey and the Tees, Tyne, and Clyde, could not be borne out. He was of opinion that the proposed training walls would not answer, and that in order to make the flood tide flow into the channel indicated, breakwaters or something of the kind must be carried down to meet the tide and carry it into the channel. The velocity of the river would be decreased, and there was no part of the river that would not be affected by loss of tidal water. The river would be rapidly silted up, and the sea channels would suffer more by the action of the sea than by the silt brought down. These effects would be gradual; but more, he believed the new channel would extend the present mid-channel banks into the lower part of the river, so that the tendency would be to perpetuate the disadvantages to the lower part of the river, which had recently been experienced in the Garston channel. lucking Bank had not increased of late, as Mr. Leader Williams said, but had actually decreased. The proposed new works would tend to take the bank lower down the river, and that interference was to be deprecated, because it might cause greater inconvenience than at present existed. He would, therefore, look with apprehension upon any interference with the stream.

Captain Hills was cross-examined at considerable length; but he stoutly adhered to his views adverse to the practicability and safety of the scheme.

Mr. Lyster, engineer to the Dock Board, gave evidence to show that the river and the property of the Board would be prejudiced by this canal, and then

Mr. Vernon Harcourt, C.E., was examined. In reply to questions he said he was the author of several books on estuaries, rivers, canals, and tidal streams, and had had practical experience in such matters in his capacity as engineer to the West India Docks and in other directions. He had examined the estuary of the Mersey, and he quite agreed with Captain Hills that the Mersey did not resemble any other river. The nearest approximation he could find were some small jetty harbours, such as Calais and Ostend. He believed that the effect of training walls in the Mersey would be to cause accretions along the banks, and any such accretions would be most detrimental to the depth of water at the bar. The proposed channel might be commenced by training walls, but he did not believe they could keep them at a level with the banks, and they would have to be raised. If they were left at the level proposed they would have an injurious effect on the estuary, because the sand, instead of wandering over the estuary, would be confined, and would not be influenced as it now was. He knew the Seine, and in that case reclamation had followed upon the construction of training walls. Reclamation was not the original intention; the same thing had occurred in the Fen rivers. He had known of no training walls which had not been followed by reclamation. Captain Hills' statement as to the rapidity with which the silting up had followed the training walls on the Seine was perfectly accurate. Between 1848 and 1875 the tidal capacity had been reduced by 274,000,000 cubic yards, and from 1875 to 1880 by 40,000,000. It would not be safe to draw conclusions as to the Mersey from the Tees and the Tyne, because the conditions would be very different. His opinion had always been that it would be dangerous to interfere with the estuary of the Mersey, because any training walls would cause accretions that would diminish the tidal ebb and flow, and that would mean deterioration of the channels outside the river, and probably the diminution of the water over the bar.

Sir Frederick Bramwell, C.E., a vice-president of the Institute of Civil Engineers, was also examined on behalf of the petitioners. Being asked what was his conclusion as to the effect of the proposed low-water channel and canal upon the estuary of the Mersey and upon Liverpool and Birkenhead, he replied: I have come to the conclusion that if the channel be made from Runcorn to Garston, and if it can be maintained, the extreme probability is that it will have a disastrous result upon the estuary and upon the towns and trade of Liverpool and Birkenhead. I think there will be a bar deposited at Garston, unless there be a current in the river sufficient to carry off the silt, and that would necessitate the prolongation of the training walls to the sea. The case of the Tees is to my mind an evidence in favour of the opponents rather than in favour of the promoters, because there is an accretion at the top of the training walls as I believe there would be in the Mersey, and in the Tees it has been found necessary to carry the training walls into the sea.

Mr. Bidder: Suppose the channel made, what do you say as to the prospects of maintaining it?—I believe it will fill up with lateral drainage from the sand, and that it will only be kept open by continual dredging.—And that would extend over the whole length of the canal?—Yes. Looking at the mouth of the estuary of the Mersey and to the storms which prevail there, you will have great difficulty in making the channel, and it might be distorted by some violent gale. The channel is to be only 12ft. below low water, while the canal is to be 24ft. If, therefore, a steamer, drawing 20ft. of water came over the bar, the captain would try to get to the canal where there would be 24ft. of water. The temptation to do that would be very great. You might have a ship going up when the tide was ebbing. Take a screw steamer drawing more water at the stern than in the fore parts. If her stern took ground and the tide came down, she would swing round across the channel, and she would wreck herself and the channel.

Mr. Pember: I suppose this would not be the only channel which is accessible only at certain times of the tide, and in which it would be necessary for captains navigating it to provide against mistakes?—Witness: Oh no.

Mr. J. W. Barry, civil and mechanical engineer, in the course of his evidence, said he was at present engaged by the Corporation of Warrington in preparing a scheme which would be proposed in the event of the Manchester Ship Canal not being proceeded with. The scheme of the Warrington Corporation is to improve the navigation of the river between Runcorn and Warrington to provide for the traffic of barges drawing 7ft. or 8ft. of water. He added: I have made observations in regard to the tide and other matters connected with the river. I have known the Tees for twenty years, and one of my first works was in connection with the reclamation of land by Sir John Hawkshaw. Observations in the Tees are very apt to mislead, because the cases of the Tees and Mersey are entirely different, the essential difference being that in the case of the Tees the training walls are carried into the sea. There are other local differences, and the fact that there is no town of importance below which can be affected. I do not believe the proposed training walls in the Mersey will answer the purpose, and if the channel is to be trained at all it must be trained by walls extending higher than the tops of the sandbanks. If that is done, I think there will be a tendency to accretion behind the walls, Mr. Yorke: Do you think dredgers will have to be constantly kept at work?—I feel certain of it.

Mr. Deacon, C.E., engineer to the Corporation of Liverpool, was also examined against the Bill, and the remainder of the opposition evidence up to the present time has been mainly upon navigating and commercial questions.

MEETING OF THE GERMAN IRONMASTERS' ASSOCIATION.

In the Tonhalle at Dusseldorf, where two years ago the Iron and Steel Institute of Great Britain held its autumn session, the ironmasters of Germany have this week been holding their annual spring meeting, under the presidency of Herr Lueg, of Oberhausen and Dusseldorf. From a statement made by the secretary, it appears that the number of members of the Society now amounts to 559, while the Society's Journal, "Stahl und Eisen," has 1250 subscribers. The School of Mines at Bochum, which is under the patronage of the Society, is making very satisfactory progress, as was testified by a collection of drawings, &c., executed by the students of the academy, and exhibited on the walls of the Tonhalle at this meeting. The first paper was read by Herr H. Jacobi, of Gutehoffnungshütte, on "The Employment of German in place of English Iron in German Shipbuilding." The speaker said that Germany had now taken the first step towards making herself independent of foreign countries in the matter of iron shipbuilding, and was now more and more supplying the increasing demands of German dockyards out of her own resources. It had, he said, become an object of ambition with German iron manufacturers to satisfy the whole of the requirements of the German shipbuilders. In this, however, they had only partially succeeded. The reasons why they had been unable to do more were gone into at some length by Herr Jacobi. Shipbuilding, he said, particularly in the case of vessels designed for ocean traffic, naturally followed English models. The German iron shipbuilding business had, from the first, been carried on under the management of engineers and foremen brought from England. German rolling works were not yet in a position to supply all the requisite plates, or at least, not plates of the sections required. Hence, it was necessary to import materials from England, where the shipbuilder was constantly able to obtain what he wanted promptly. German shipbuilders would now be able to conduct the business of iron shipbuilding without the assistance of English engineers and foremen, but, as a matter of fact, they still retained this assistance in most instances. They also continued for the most part to obtain their iron materials from England, although German ironworks were anxious and able to supply them with a great deal of the exact class of wares they required. There was, however, one point in which most of the German firms were behind the English. When the shipbuilder asked the question, "How much will the materials cost for a steamer of such and such a tonnage, built according to the prescriptions of such and such an insurance office?" the German ironmasters could not give an immediate answer, while the Englishman could tell the price at once. The shipbuilder on putting the above question to a firm in some English iron-manufacturing town, would receive without delay the average price per ton. A German manufacturer in such a case would generally ask for detailed specifications, and would tender for the different parts separately. It was therefore no wonder that German shipbuilders still continued to adopt the simpler procedure, and went on ordering their materials from England without troubling themselves about the more troublesome German manufacturers. Moreover, in case the shipbuilder took the trouble to examine the German detailed prices, and to strike his average from them, he would find that the cost of his materials would be considerably higher if ordered in Germany than in England. Then, again, in the few cases where he had actually ordered his iron in Germany, he constantly had to complain of unpunctual delivery, whereby he was himself prevented from delivering at the time he had contracted for. These, then, are the chief reasons why English materials are still preferred to German in German shipyards, viz.:—(1) That the German ironmasters require an exact specification before they can give the price for the materials for a vessel, while the English require nothing more than the tonnage and the class of insurance of the vessel; (2) the price of German materials is higher than the English; and (3) German ironworks do not execute their orders with sufficient punctuality, and with the promptitude which can be relied upon in the case of orders sent to England. With regard to the first point, the speaker held that, with a little attention, German rolling mills would be able to make tenders at an average price, as was done by English manufacturers, especially if the quantity of materials was given under the separate heads of plates and angle-bar iron. Herr Jacobi had gone through a number of specifications, and had found that the proportion of figured plates to the rest was about 10 per cent, the few conical plates not being included under the former head. There was also included about 5 to 10 per cent. of bar iron, of the ordinary dimensions. Owing, however, to the difference in the style of building of different vessels, it was not possible to fix precisely the proportion to the tonnage of the vessel, or to the total quantity of iron employed in its construction. But if shipbuilders would only state the total quantity of iron required, and the proportion of the plates to the whole, that ought to be quite sufficient for the German manufacturers. The speaker then quoted some figures in the actual specifications of three different vessels, illustrating the proportions of the different descriptions of iron employed.

In the first case that of a vessel of 3000 tons, with water ballast tanks, built of iron with steel angles and classified according to the German Lloyd system, the quantities in kilogrammes were as follows:—Ordinary plates, 636,000; figured plates, 57,000; angle steel, 226,500; flat, round, and half-round bars, 40,000; and collar iron, 23,500; making a total of 983,000 kilogrammes.

In the second case, a vessel of 850 tons, with water ballast tanks, classified according to the system of the Bureau Veritas, the respective quantities in kilogrammes were:—Of ordinary plates, 182,000; figured plates, 18,300; angle iron, 73,300, and various kinds of bar iron, 9500; making a total of 283,100 kilogrammes.

In the third instance, a vessel of 1200 tons, built entirely of steel and water ballast tanks, classified according to the English Lloyd's system, the quantities in kilogrammes were respectively:—Of ordinary plates, 275,000; figured plates, 25,000; angle steel, 87,000; round and other bars, 8300; and other steel, 7000; making a total of 402,300 kilogrammes.

It was usual with English firms to contract to deliver the whole of the requisite materials for a vessel, and this custom was so general and convenient that German manufacturers would have to adopt it in making their tenders. This they could do by entering into arrangements with other firms manufacturing such descriptions as they did not produce themselves. The habit of German firms in tendering only for some one particular description of the various materials in a specification, gave the shipbuilder an immense amount of trouble, besides leading to frequent delays, misunderstandings, and losses.

With regard to the second point, the speaker said it could not be denied that English iron was cheaper than German. At the present time the prices in the North of England for the ordinary materials for shipbuilding were as follows: Ships' plates, £6 $7\frac{3}{8}$s. per ton; angles, £6; collar iron, £8 15s.; or Franco Bremerhaven, or Hamburg, the prices per ton were, ships' plates, 135 marks, or £6 15s.; angles, 127 marks, or £6 7s.; and collar iron, 182 marks, or £9 2s. The German prices, on the other hand, were at the present time—Franco Bremerhaven or Hamburg—ships' plates, 180 marks, or £9; angle, 140 marks, or £7; and collar iron, 185 marks, or £9 5s.

The various insurance companies require that English iron shall be capable of bearing, without expansion or contraction, a longitudinal strain of twenty tons to the square inch, and a transverse strain of ei teen tons. This degree of strength is guaranteed by English manufacturers, but it is very rarely put to the test, because such test is not imperative. English iron, however, is generally capable of standing this strain, but not much more without suddenly breaking. The chief defect of English iron is its great lack of homogeneity or want of uniform quality. This often shows itself by cracks produced in the process of manufacture. Almost all the frame angles, obtuse angles, made from the right angle with the material at a red heat, show longitudinal cracks, the so-called welding joints. But such materials, if the defects are not too serious, are employed without hesitation, as the frames cannot be produced free from such faults out of English iron.

Herr Jacobi then proceeded to describe to his audience what he said was the ordinary process of manufacturing ships' plates in the North of England, and attributed the cheapness and irregular quality of English plates to what he represented as the universal practice of throwing in all sorts of old iron, rails, chippings, &c., without any hammering or other preparation, and rolling it all up together into the finished article. The exterior plates between which the rubbish is rolled, he says, is Cleveland iron, costing now only 38s. 9d., and containing $1\frac{1}{2}$ per cent. of phosphorus, and about 2 per cent. of silicon. The waste from first to last is trifling, and the whole process is so economical as to enable the plates to be turned out very cheaply, but Herr Jacobi considers that cheapness is attained at the expense of quality, and does not recommend German iron manufacturers to imitate the practices in vogue in the North of England. Other means, he holds, must be resorted to in the attempt to compete with English iron employed in German shipbuilding. He continues, "How well the English themselves are aware of the bad quality of the ordinary material used in shipbuilding appears from an article in the *Daily Telegraph*, which appeared shortly after the foundering of the Cimbria, and which is given as expressing the opinion of a shipmaster. 'How,' he asks, 'can vessels help going down, when the metal of which they are built costs no more than £6 a ton? What sort of quality is to be had at that price? Some of the plates made of Cleveland iron are like glass; I have seen them break to pieces by merely falling down,' &c. An English technical journal endeavoured in a long article to prove these statements untrue. It appealed to the fact that the production of these materials for shipbuilding had so rapidly increased of late in the North of England as showing the complaint to be groundless, and urged that shipbuilders would not continue to employ the plates if they were really so bad as represented." This argument, Herr Jacobi says, is not correct, for competition has forced people to build ships with the cheapest materials satisfying the conditions of the insurance companies. The *Cologne Gazette*, on the 3rd of February last, referring to the Cimbria disaster, discusses the reasons why such calamities are of increasing frequency, and says that "the belief in the small value of English ships' plates is so prevalent and general that the very expression 'ship's plate' has come to signify a plate of inferior quality." With pieces of the plates of the Cimbria some official experiments have been made within the past few days in Germany, and, according to Herr Jacobi, the result has been very unfavourable as regards their quality.

The conditions imposed by the English and French companies in the classification of vessels have been determined by the cheap material employed in shipbuilding, for it was impossible to escape the influence of the manufacturers. To alter the specifications would have caused a revolution in the trade, and many rolling mills would have been ruined. The German Lloyd, the company conducting the classification of German vessels, is unfortunately not powerful enough to take independent action in the matter, and has been compelled to follow in the wake of the older societies. Of the three classifying corporations which prescribe the minimum thickness of the various parts of a vessel, only the German Lloyd and the Bureau Veritas allow a reduction in case the material is of demonstrably superior quality. The English Lloyd has hitherto refused to authorise any such reduction. Hence, considering the great difference of price, the use of German materials is excluded in the case of all ships built according to the rules of the English Lloyd. Now, at least half the vessels built in Germany are classified by the English Lloyd, and therefore it is of the highest importance for German manufacturers to induce the English company to make a concession where iron of superior quality is employed. It would, perhaps, be advisable for German ironmasters to unite with German shipbuilders in making an appeal on the subjects. The materials would then in all cases have to be tested by an expert belonging to Lloyd's, as is in fact already done in the case of steel. The insurance companies allow a diminution of 20 per cent. in the dimensions where soft steel is used of a minimum strength of 27 tons and a maximum of 31 tons per square inch. It would only then be right if the English Lloyd's made a corresponding reduction. The strength now prescribed is 20 tons per square inch strain and 18 tons transversely, without extension. If this strength is reached, the iron will suddenly break if a greater strain is put on it, and it seldom shows an extension of more than from 3 to 5 per cent. in a longitudinal direction. In the transverse direction the lengthening is mostly zero, and the prescribed test is only just satisfied. Now, it is precisely this small capacity of the material for extension that causes such large holes to be made in a vessel's side in case of collision. The plates struck break like glass, and the leak made is as large as the part of the vessel struck. If the iron were tough, the result in case of collision would be indentations, with cracks of a less dangerous character, such as could often be stopped up. The German War Navy has employed German materials in its construction with the best results. The ironclad corvette Friedrich der Grosse, when she ran aground in 1878 in the Great Belt, had no hole made in her hull, but only an indentation about 9ft. long by $2\frac{1}{2}$ft. broad, without the least symptom of leakage. If she had been built of English plates, she would certainly have driven a hole in her bottom of the size of her indentation.

According to the classification of this Society—that of the German Ironmasters—the materials employed in construction in Germany, as was settled in May, 1881, must be of a strength of 36 kilogs. per square millimetre and 12 per cent. expansion, in the case of angle iron, while for plates the figures are 35 kilogs. strength longitudinally, with 10 per cent. extension, and 28 kilogs. transversely, with 3 per cent. extension. These materials would, I believe, prove decidedly superior to ordinary English iron for the purpose of shipbuilding, and we ought to try and induce the various insurance companies and the English Lloyd's, in the first place, to consent to make a corresponding reduction in the dimensions. In order to ensure that the iron employed really satisfies the conditions of the insurance companies, it is imperative that it should be tested by their agents. Although that process would give more trouble than at present to shipbuilders and experts, it would have the advantage of clearly showing what sort of ship was really being turned out. A good deal of material which is now blindly employed would also, no doubt, be rejected. If the testing process were strictly carried out, English prices would soon begin to rise, and thus there would be a better prospect for German materials. But a mere reduction in the dimensions would of itself be insufficient to remove the difference of price between the low quality English and the good German iron. Another thing the German manufacturer would require would be a reduction in the cost of carriage for iron for shipbuilding. The English ironworks must have direct water communication with our shipbuilding yards. Their cost of carriage is low, while we are not only confined to the dearer railway carriage, but also, through the peculiar site of most of our dockyards, have the additional expense of a reloading. As English iron is produced under more favourable conditions than ours, and is also imported duty-free, a reduction of the railway tariff would only partially compensate our iron trade.

The reduction in restrictions, already conceded by different insurance companies in the case of soft steel, is causing this material to be increasingly employed in shipbuilding. Many vessels have recently been entirely built of it, the price being practically not greater than for iron. The smaller weight of the hull enables the vessel to carry more, or for a given tonnage the hull may be smaller. This enables the vessel to be propelled by smaller engines, and thus in the end a steel ship is no dearer than one of iron. Moreover, as in a collision a steel vessel would prove stronger and suffer less damage than an iron one, we cannot but regard steel as destined to be the material for building the ships of the future In steel production Germany is not at so great a disadvantage, compared with England, as in the case of iron of low qualities, but owing to her fortunate position England still has the advantage over Germany owing to the cost of carriage being lower. This is a most essential point, and it behoves us in Germany to press for a reduction of the tariff for all materials employed in shipbuilding.

After explaining the causes of the comparative want of promptitude of German iron manufacturers in executing orders for ship materials, Herr Jacobi said that an authoritative settlement of the Freeboard question was of great importance to German manufacturers, as the real carrying capacity of vessels depended on it, and merchants would have to resort to other expedients than overloading. To increase the carrying power of vessels to the utmost there were two courses open: either the best materials must be employed in building, or vessels must be more complete in construction than at present. The former course appears the most promising.

Another point was that of anchors and chain cables. Here, again, the English produced the articles at prices so marvellously low that the German manufacturers could not compete with them. England was able to do this because the price of iron there was so low, and because she had command of the markets of the world, so that she could manufacture wholesale, and therefore with greater economy, incidental costs being reduced to a minimum. Germany, too, has no official department for testing these articles, a want which she ought to endeavour to get supplied as soon as possible. That in quality the German anchors and chains are equal to the best English, Herr Jacobi said was proved by the experiments made some time back by the German War Navy, which resulted in all orders of the German Admiralty being thenceforth given exclusively to native manufacturers. The ordinary English descriptions were so cheap—and also of very inferior quality—that German manufacturers could not compete unless there were an obligatory Government test of these articles introduced into Germany. There were, however, a number of subsidiary articles in wrought iron in which those of German manufacture are preferred to the English, because they are of better material and are manufactured with greater exactitude.

Finally, Herr Jacobi observed that the sale of engines of German make had of late been increasing, and in vessels built in Germany they were taking the place of engines imported from England. Prices were, however, kept very low by the cheapness of the inferior classes of English engines. For an English engine of really excellent quality a high price had to be paid, as well as for good German engines. If German manufacturers were tempted to go in for low prices they would have to carry out economies which were only too likely to give their goods a bad name. It was to the interest of shipowners to pay a fair price for the most important of all the parts of a ship, or, in other words, to take care that it should be of really good quality.

A long and lively discussion followed the reading of the paper, in the course of which Herr Stromeyer, an agent of the English Lloyd's, expressed his conviction that that body would be willing eventually to consent to a reduction in the thickness of plates where material of really superior quality was employed. Herr Massenez also pointed out that the British Iron and Steel Institute was using its best endeavours in favour of the employment of a better quality of material in shipbuilding. After a vote of thanks to Herr Jacobi, and the reading of an interesting paper on improvements in coke ovens, by Herr Hussener, of Gelsenkirchen, the business part of the proceedings was brought to a conclusion, and the assembly adjourned.

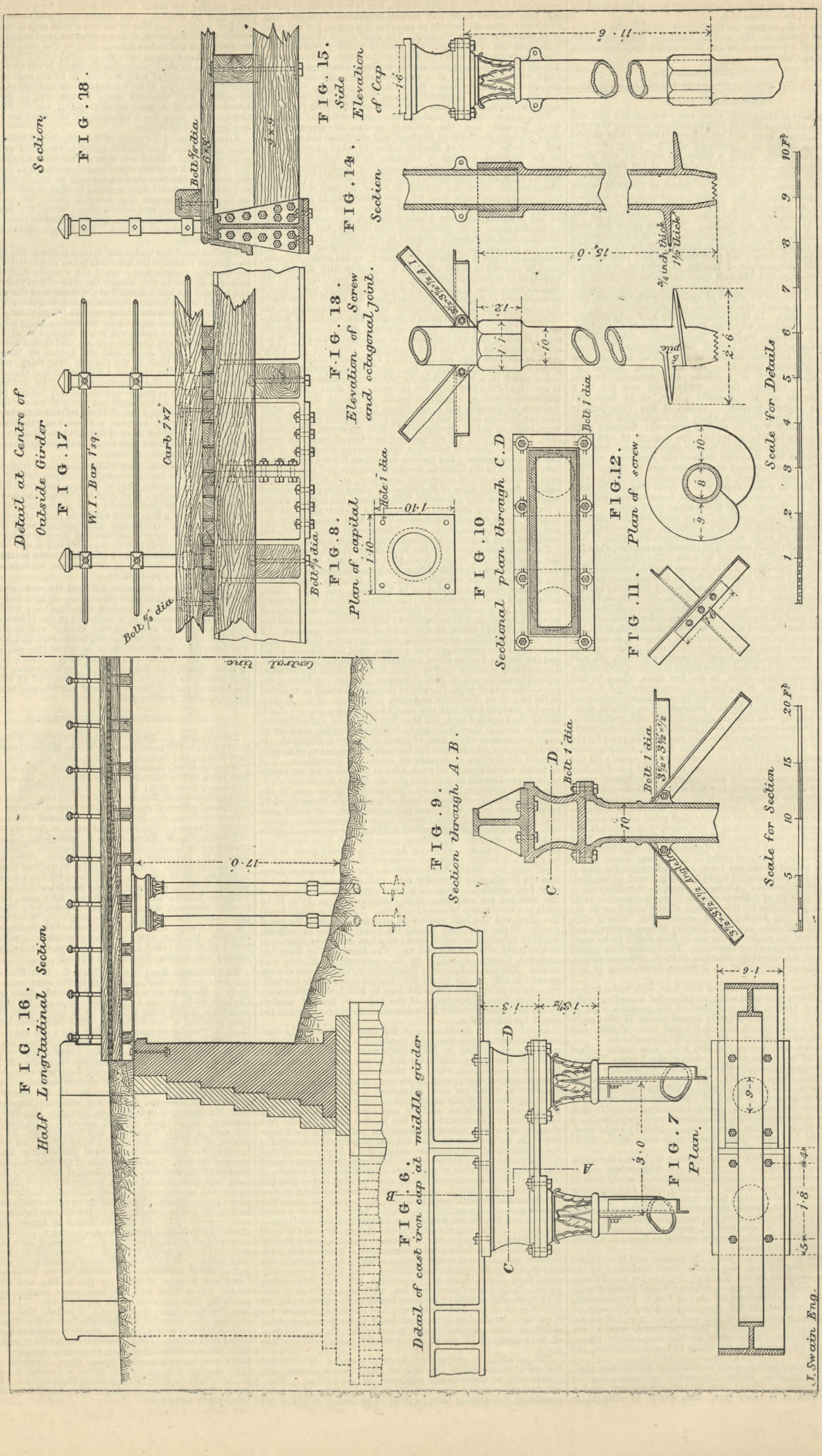
Association of Municipal and Sanitary Engineers and Surveyors.—The annual meeting will be held in Oxford, on Thursday, Friday, and Saturday, the 28th, 29th, and 30th June, 1883. The members will assemble at twelve o'clock—noon—on Thursday, 28th June, in the Council Chamber, Town Hall, Oxford. Business, Thursday, June 28th: 11 a.m., Council meeting, at engineer's offices, Bath-court, New-road, Oxford; 12 noon, annual meeting of members, in Council chamber; annual report, election of officers, general business, &c. &c., president's address and description of works. Papers: "The Separate System of Sewage as carried out at Reading," A. W. Parry, Assoc. M. Inst. C.E.; "The Supply of Electricity by Local Authorities," Killingworth Hedges, Assoc. M. Inst. C.E.; discussion on papers by Messrs. Parry and Hedges. The annual dinner, at 6.30 p.m., at the Clarendon Hotel. Friday, June 29th: 10.15 a.m., start from Town Hall to visit the works at Magdalen Bridge; 11 a.m., leave Magdalen Bridge for Sewage Pumping Station and Sewage Farm; 2.30 p.m., discussion, in Council chamber, upon the works described by the president; paper on "Water Supply of Abingdon," G. Winship, Assoc. M. Inst. C.E.; paper on "Jointing Sewer and Drain Pipes," H. Percy Boulnois, M. Inst. C.E.; discussion on ditto. Saturday, June 30th: 10.15 a.m., start from Town Hall to visit Abingdon Waterworks; visit objects of interest in Oxford.

The Steamer Bass Rock.—This is the first Hull vessel which has been built, owned, and sailed by the same man. The Bass Rock is the first of a new line of steamers, built by Mr. D. P. Garbutt, to be known as the Rock Line, and her sister ship, the Bell Rock, is now being fitted for sea in the Victoria Dock, having been launched a few weeks ago. The Bass Rock left the Albert Dock on Tuesday forenoon, 12th inst., for a run out to sea, and on the 19th inst. for Bombay. Her engines, which have also been constructed by Mr. Garbutt, at his works in Spyvee-street, were used for the first time as the vessel was being towed to the entrance lock. The order was given from the deck, and at once the engines were in motion, under the most perfect control. There were on board the Bass Rock the owner, Mr. W. P. Garbutt, managing owner of the Mascotte, now on her way from Bombay with 5200 tons, Mr. Spear, Board of Trade surveyor, Mr. Stevens, Lloyd's surveyor, Mr. Gemmel, shipyard manager. The vessel was under the care of Capt. Thompson, and the engines, &c., under the charge of Mr. Key, the general manager of the engine works, besides other gentlemen and several ladies, all of whom heartily enjoyed the trip. The Bass Rock is of the following dimensions:—Length 340ft., and 42ft. beam; depth of hold, 28ft. 3in. She has been built under special survey, to class 100 A1 at Lloyd's, and also under the survey of the Board of Trade, and will have their passenger certificate. The vessel has an extra number of transverse bulkheads, and in several parts of the ship exceeds in strength the requirements of Lloyd's and the Board of Trade. She has been specially constructed to carry troops, horses, and cattle, having the most perfect means of ventilation. The vessel has a large carrying capacity, having nearly 7000 tons measurement, or about 5000 tons dead weight. She is fitted with steam steering gear, with Harfield's patent steam windlasses, and has five steam winches by Messrs. Good and Menzies, of Hull, for the loading and discharging of cargo. She is fitted with two fresh water condensers, capable of producing 2000 gallons of water per 24 hours. The Bass Rock is impelled by a pair of compound, inverted, direct-acting screw engines, the diameter of the cylinders being 44in. and 84in. respectively, by a 54in. stroke. Steam is supplied by two double-ended steel boilers, 14ft. 9in. in diameter by 18ft. long, working at 80 lb. per square inch, and having a heating surface of 7500 square feet; cooling surface, 4500 square feet; diameter of propeller, 17ft. 6in. by 23ft. 6in. pitch, fitted with four movable blades. On her trial trip, with 58 revolutions, $27\frac{1}{2}$in. vacuum, and 77 lb. of steam, the engines gave a speed of 13 knots per hour, the indicated horse-power being 1980.

CRAWFORD BRIDGE, SINGAPORE.

MR. THOS. CARGILL, M.I.C.E., ENGINEER.

(For description see page 472.)



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TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 1d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

T. S. (Pittsburgh).—*There is no such work as you want in existence. It has yet to be written.*

L. AND T. (Pendleton)—*We do not keep or supply the specifications referred to. You may consult them at the Patent-office, Southampton-buildings, Chancery-lane.*

DRAUGHTSMAN.—*The relative weights at the different velocities* v, *due to the different heights, will be found by the formula* $\frac{W v^2}{2 g}$, *in which* W *is the weight and* g *the usual value expressing the acceleration due to gravity. See Molesworth's "Pocket-book," or some work on Mechanics, or Clark's "Tables and Formulæ."*

C. V.—*The black and white specks in your sheets are due to the use of badly hammered puddled bar; in other words, they are caused by impurities—principally cinder—in your iron. Something may be due to bad puddling; but this is not likely, although the presence of white spots seems to indicate it. You must hammer your blooms better. If you like to give us more details of your mode of working, we shall be able to advise you further.*

J. H. W. (Nottingham).—*Your plan formed a portion of one of the original schemes for the construction of the Channel Tunnel, and it has been repeatedly revived. It has invariably been condemned by competent engineers—first, because the construction of a ventilating shaft in mid-channel would be enormously expensive; and because, in the second place, it would constitute a most dangerous obstruction in a very crowded waterway.*

ERRATUM.—*In our article on the Elwell-Parker battery, published last week, a misprint occurs, the revolutions of the engine at Albrighton being given as* 120 *per minute, whereas the engine really makes* 1200 *per minute.*

LINOLEUM MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers kindly furnish me with the names of manufacturers of machinery for making linoleum? G.

London, E.C., June 20th.

LEAD ROLLING MILLS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly tell me if a large mill for rolling thin sheets can be worked by frictional gearing instead of reversing engines?

Battersea. R. H.

PRESSURE ON ROCK DRILLS.

(*To the Editor of The Engineer.*)

SIR,—Could any of your readers give me information concerning the force of impact in foot-pounds required by an efficient rock drill, or a measure of the pressure brought to bear on the drill? F. H. W.

London, June 19th.

BAD ELECTRICAL CONDUCTORS.

(*To the Editor of The Engineer.*)

SIR,—Perhaps some of your readers can help me in the following matter:—I want to know the name of a bad conductor of electricity, and I cannot find one in any book, and I have consulted a good many treating of electricity. I do not want a non-conductor, but simply some material which will offer a considerable area of possible constant resistance to the passage of electricity.

For my purpose high resistance coils of fine wire, such as are used in arc lamps, are quite useless, and the only thing that I have found hitherto to suit me has been German silver wire; but to get as much resistance as I want, namely, from 200 to 5000 ohms, I have to use far too much wire, and of too small a section. I have tried badly baked carbons, such as are made for arc lamps, but I cannot find one bit of a thousand which will suit. They either conduct too much or not at all. Is there any alloy which will not melt readily, and yet will answer my purpose? What, for example, is the conductivity of type metal as compared with copper? How about powders—as powdered carbon, lead filings, and such like? I shall be very much obliged by any information on these points. ELECTRODE.

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DEATH.

On the 16th inst., at 107, Ledbury-road, Bayswater, ROBERT GRIFFITHS, inventor of the Griffiths' Screw Propeller, aged 77.

THE ENGINEER.

JUNE 22, 1883.

STEEL VERSUS COMPOUND ARMOUR IN ITALY, RUSSIA, AND DENMARK.

WE have now a good deal of evidence before us as to the conclusions arrived at in Italy, Russia, and Denmark, on the results of the recent competitive trials made in those countries. We gave a translation of an Italian report on trials made at Spezia, subsequent to those reported by us at the end of last year. The speech of his Excellency the Minister of Marine, Rear-Admiral Acton, in the Chamber of Deputies at Rome, which we have before us, deals more fully with the entire question, and cites conclusions obtained from Russian authorities, and in the *Army and Navy Gazette* of June 16th is an article containing extracts from the Danish Ordnance Select Committee Report. These may well be taken together. Admiral Acton admits that photographs giving the views of the plates tested at Spezia might give an impression very unfavourable to the compound plates to any one who did not know the circumstances connected with the bolting; in fact, who did not know that six bolts were matched against twenty. He explains that subsequent trials on the fragments of plate with medium guns showed a great advantage on the side of the compound plates. He then dwells on the different natures of the resistance of compound and steel plates. The former has a very hard face, which breaks up projectiles in a remarkable way, and would have a still greater advantage in this if struck obliquely. Its soft foundation plate, however, requires rigid backing, such as it did not get at Muggiano—that is, at Spezia—but such as it would have in the side of any vessel.

The steel armour is actually penetrated and breaks up under repeated blows from projectiles of medium calibre. The Admiral remarks that in preferring compound armour to steel Italy is in good company with England, Germany, Austria, and Russia; indeed, France herself continues to employ compound as well as steel armour. Recently some magnificent Krupp steel projectiles practically produced no better results against compound armour than the Gregorini chilled iron shot. On service it is held by Admiral Acton that a ship would much more frequently be exposed to the continued fire of medium guns than to even a single shot of a really heavy gun; and compound armour resists this continued fire well, while steel succumbs to it. He would be disposed to test compound and steel plates respectively by one or two heavy blows and a number of medium ones. After explaining how the particular tests employed at Muggiano were arrived at, and giving a list of English, Russian, American, and other ships, for which compound armour is to be employed, supplied from the firms of Messrs. Brown and Messrs. Cammell, he quotes from the Italian officer on special service at the St. Petersburg trials of March 29th and 30th last the following words:—"The tests executed on the 8th instant upon the Cammell plate —third and fourth shots—are the sequel to those of the 24th of November. The projectiles broke up upon the plate without causing practical damage to the same, so that it would serve for two or three more shots, which will probably be executed upon it;" and, again, "Admiral Schwartz, head of the Russian artillery service, and Admiral Schestakow, Minister of Marine, notwithstanding the Spezia tests in November and those made in Sweden, is strongly of opinion that the compound plates are superior to the Schneider. I thought it well to refer these points to the officials of the marine, with whom I spoke at the Polygon, among whom was Admiral Stahl, head of the Testing Commission, and all share the opinion of Admiral Schestakow and Admiral Schwartz, that the compound plate is superior to the Schneider." Admiral Acton then finally gives it as his opinion that "there can no longer remain any doubt as to the real superiority of compound armour which we have adopted for Italy, which England, Russia, Germany, and the other Powers continue to prefer, and which even France adopts in competition with Schneider, without arresting its manufacture." The Danish Ordnance Committee, on the other hand, argue as follows from their experiments:—"The plates have suffered in proportion to the number of shot kept out. The latter being the main point, it must be acknowledged that next to the steel plates, the greatest resistance has been rendered by the iron plates, which thus have discharged their duty best; whereas the compound plates are inferior to the other sorts in both respects."

It seems a strange thing that such different apparent results should be exhibited in different countries, especially that the Danes should prefer steel plates in the teeth of conclusions arrived at by Italy and Russia after experiments conducted on a much larger scale. The fact is that experiments and results can be considered from different points and with different objects in view. Let us see what features we are sure of in the conditions of the question.

Speaking generally, the compound principle appears to have a great advantage in one respect. The body of the shield requires tenacity, while the face should be hard in order to break up the shot before they get their points in, and so receive support from the plate itself. In fact, qualities of different kinds are called for in the front and back of plate. In the case of a homogeneous mass of steel the best combination or compromise of qualities must be employed. In the case of the compound plate the metal suited to each part can be there employed, that is, the shield may have a hard steel face on a tough iron foundation plate. The solid steel plate then must have a softer face than is desirable to secure the toughness required throughout. Its advocates probably, therefore, depend on the superiority of steel over iron in tenacity, on the advantage of the whole plate being stiff and less likely to bend than the wrought iron, and on the hammering to which it is subjected in making. As we have before stated, we believe that the advantages of the hard face and tough back of compound plates are very great; but we cannot help thinking some day hard and soft steel may take the place of hard steel and soft iron. Our present business, however, is with compound and steel plates as they stand, and we are glad to find that the judgment is strongly in favour of the former in almost all cases. Apart from the actual comparison of results under a fire which is at all a match for the armour, we feel with Admiral Acton, that thick armour is much more likely on service to be fired at by guns far below its power, and with projectiles striking it obliquely; and we know that under these conditions steel gradually shatters, while iron suffers very little, to say nothing of the advantage of the hard steel face. Of course, it must be imperative that the plate cannot be punched or perforated completely. In wrought iron it becomes possible that live shell might be driven through, but this we regard as out of the question with steel-faced or steel armour. We believe, then, we are doing well with compound armour.

With regard to the experiments themselves, we do not think that they are conducted always in a sound way, admitting of comparison with each other. In a recent article on "Hard Armour"—ENGINEER, May 4th last—we pointed out that, even in the most recent experiments against hard armour which cannot be perforated, shot are always matched against plates according to their power of perforation—which is misleading when the shot are employed in work of a different character. Against hard armour, including chilled iron, steel, and the thickest kinds of steel-faced plates, the shot may either drive their points slightly into the surface or, as in chilled iron, chip a little of the face off, but their further action is that of a hammer breaking the plates across. No hole is made, and it is difficult to conceive that "penetrating power," which is work proportioned to the size of hole which might be made in soft plates, is the proper standard of comparison. Surely the total stored-up work, delivered on the point of impact as far as the shot holds together, is the standard to employ to compare shot fired against the same plate. Probably this is the standard employed by the Danish officers. There is more difficulty in comparing experiments against plates conducted on different scales, such as those of Spezia and St. Petersburg. We have, in the article referred to, taken the striking energy per ton of metal in the plate. This supposes that the work of cracking plates through is in proportion to their mass, which is hardly likely to be correct. Nevertheless, it is probably as near the mark as anything we can at present suggest. By this it appears that the blows recorded by us in our reports of the Spezia and St. Petersburg trials had the following work in them per ton of metal in the plate struck. At St. Petersburg, taking the plates at 12¼ tons each, the heavier blows fired first had 8704 foot-tons energy, and the lighter ones, which followed, 5228 foot-tons each, or 711 and 427 foot-tons per ton of plate. So that the Schneider, which was broken up and a quarter of the plate stripped off after three blows, had received 1564 foot-tons, while the Cammell-Wilson remained good after receiving 1991 foot-tons for each ton in the plate. At Spezia the plates weighed about 31½ tons each. Consequently, the lighter and heavier blows of about 21,000 and 33,800 foot-tons respectively, gave on the plates about 666 and 1070 foot-tons for each ton of metal in the plate. After the second round, the Cammell and Brown plates were broken and stripped. Schneider's was really broken, but held up by the backing. Each had then had about 1732 foot-tons per ton of plate. The Schneider received two more blows, making a total of 132,000 foot-tons, or 4200 foot-tons per ton of plate. Bolted as it was, it behaved excellently, and although fragments were hanging by single bolts at the top, it could not be said that much more than about a quarter of the backing was exposed.

It will thus be seen that the Spezia plates were subjected to a much heavier shock of impact than those at St. Petersburg; that is, to blows of 666 and 1070 instead of those of 427 and 711. Let us compare the best compound and steel plates. The Cammell-Wilson at St. Petersburg has now, however, borne 1991 foot-tons per ton, without any complete through fracture, whereas the Schneider, at Spezia, after 1732 foot-tons, that is, after the second round, was broken through in different directions. We could hardly say how many of the cracks went entirely through it, because it was surrounded by a frame, but we could see along its edge enough to be satisfied some did so. By this mode of comparison the compound Cammell plate has already borne more than the Schneider at Spezia. In favour of the latter, however, we must urge that it is much harder to make a good 19in. plate than one only 12in. thick, and we should like to see more trials on the larger scale.

THE PROGRESS OF ELECTRIC LIGHTING.

COL. HAYWOOD has just published his report to the Streets Committee of the Commissioners of Sewers of the City of London, on the electric lighting of the Holborn Viaduct. On the whole the results of a year's experience are satisfactory. So well pleased, indeed, is Col. Haywood, that a contract for a second year's lighting has been entered into with the Edison Electric Light Company. On the 29th of October, 1881, the company asked permission to light the public ways of the Holborn Viaduct on the incandescent system. Permission was given, but owing to various causes lighting was not commenced until the 24th of April, 1882. The incandescent system had been in operation, however, on the Viaduct for some time previous to the date named, but the lighting was not held to commence until the gas lamps could be dispensed with, and this was done on the day named. In July, 1882, the company offered to extend the time of lighting for a further six months, if the City would pay as much for electricity as it did for gas. This was agreed to, and the new agreement extends from the 24th of last April to the 24th of next April, for the sum of £388 8s. 8d., being at the rate of £4 10s. 4d. per lamp per annum. The light given is estimated by Col. Haywood to be one and a-quarter times that of the gas previously burned. The total number of lamps is 92, of which 64 are arranged in the ordinary gas lamps on the Viaduct, and round the Prince Consort memorial. On the five-light column at the eastern end of the Viaduct and Snow-hill there are 16 lamps, and in the staircase buildings 12. All these are nominal 16-candle lamps. Besides this, the Edison Company has about 750 lamps fitted in private houses, shops, and the City Temple. The total length of thoroughfare lighted is 466 yards, and the superficial area about 12,000 yards. Each lamp on the Viaduct illuminates an area of about 155 superficial yards. We have already described the Edison Company's installation on the Viaduct, but it may be worth while to re-state here that the machinery for generating the electric currents is fitted up in the basement of No. 57, on the Holborn Viaduct. The premises are on the northern side of the way, between Farringdon-street bridge and the Snow-hill station of the London, Chatham, and Dover Railway; the company has also used other premises in the rear of No. 35, Snow-hill, for the purpose of the experiment. There are two of Edison's dynamo machines, each worked by a Porter-Allen direct-acting engine, capable of working to 140-horse power indicated. One dynamo can sustain 1000 lamps, the other 1200 lamps, of 16-candle power each. In addition to the two, a third, 1200-light dynamo, fitted with a similar engine, has been erected in the company's premises at the rear of No. 35, Snow-hill; this is now at work. A 250-light dynamo, driven by an Armington and Sims' engine, has also been placed in position, and is being used for supplying electrical current to such consumers as may require light during the daytime. From the dynamos the conductors were laid direct into the subways beneath the Viaduct, an opening having been made from the house vault of No. 57 into the subway for that purpose. The main conductors are formed of solid copper rods semi-circular in section, embedded in an insulating material and enclosed in wrought iron pipes; these are laid upon the brackets in the subways, provided there for similar purposes when the subways were built. From the main conductors the connections with the public lamps and with private premises were made by means of insulated cables and wires. Where the conductors pass beneath the Farringdon-street and Shoe-lane bridges, they are suspended from the girders. Owing to the contiguity of the house vaults to the subways which exist beneath the footways on each side of the Holborn Viaduct, the main conductors and the various connections with the lamps and premises upon the line of the Viaduct were made without disturbing the surface of the public ways. In fact, it has not been found necessary to make any opening upon the surface of the Viaduct for the purpose of the experiment.

It is, of course, no secret that on more than one occasion failures have taken place. Colonel Haywood has had a very accurate record kept by the police of all these, and a complete list of them, with the explanations of the company, is appended to the report. The extent and nature of these failures may briefly be stated as follows:—There were for the first portion of the experiment, until the end of August last, 176 incandescent lamps in operation, that is two lamps in the majority of the eighty-six gas lanterns, and several groups of eight lamps, each assumed to be alight 1052 hours from the 24th April to that date, which is equivalent to 185,152 hours' lighting of a single lamp. There were ninety-two incandescent lamps in operation for the remainder of the twelve months, each assumed to be alight 3228 hours, which is equivalent to 296,976 hours' lighting of a single lamp. These together are equal to a total of 482,128 hours' lighting of a single lamp. The total number of failures in the lighting from all causes was 815, counting every failure each night separately; their aggregate duration was equal to 1515 hours of a single lamp, or about ·03 per cent. of the entire lighting for the twelve months. "It may be said broadly," says Colonel Haywood, "that a defect of longer or shorter duration occurred in something like 1·17 lamps nightly out of the 176 lamps lighted in the first portion of the year, and 2·80 lamps nightly out of the ninety-two lamps lighted during the remainder of the year. The principal failures," he adds, "appear to have arisen from defects in the machinery, and many from defective carbons in the incandescent lamps." As it does not appear that anything else was left to fail but the conductors, the last remark is perhaps superfluous.

In considering these failures, they must be classified. Thus, for example, the failure of even a dozen lamps at once or during the same night would be a matter of small importance, but the going out of all of them at the same time might have very serious consequences. Now this happened no fewer than five times. We do not know how far the private lights were affected, but so far as electricity was concerned, on each of these occasions Holborn Viaduct was left in the dark for a longer or shorter period. The first event of the kind took place on the night of the 30th of August, 1882. The lights were out from 7.42 to 8.25 p.m., or very nearly three-quarters of an hour. The company explain the circumstance by saying, "Dynamo machine injured by sulphuric acid getting on it." On the 2nd of October all the lights were extinguished from 7.15 to 7.18 p.m., or for three minutes, owing to the "Connecting-rod bearing of engine overheating." On the 4th of November the lights all went out for a minute and a-half, "changing engines." On the 20th of December no light could be had from 4.30 to 10.45 p.m. The company explains, "Late in starting up, owing to repairs being in progress on one engine, and a fault developing in the dynamo driven by the other." It is also to be borne in mind that a patrol or watchman is kept constantly on duty, and that he carries lamps with him and can replace them where broken. A very large number of the failures is due to broken carbons. We may put on one side these smaller matters, and point out that so long as it remains possible for a large public building, as a theatre, a church, or an hotel, to be left in darkness for even three minutes, so long must the electric light be excluded from such structures. The failure of the lights in a theatre might produce a panic, followed by the most disastrous results. It is time that electricians recognised this truth and seriously addressed themselves to overcoming a difficulty which is in no sense or way insurmountable. No amount of excuse or apology will do. It must not be admitted for a moment that because the light only failed for even a single minute, that little harm was done. When lights go out in this way no one can tell whether there may be a delay of a minute or an hour in re-lighting them. If such interruptions were really unavoidable, then would the fate of the electric light be sealed; and this truth ought to be insisted on by every engineer and committee in an influential position.

It will not fail, we hope, to attract our readers' notice that the mere duplication of parts will not suffice to prevent such casualties as we speak of. The Edison Company claim for their installation that it is perfect, and yet it broke down completely five times in a single year. By an awkward concatenation of events, the engine of one set of machinery and the dynamo of the other broke down. The lesson is extremely important. It shows that so long as reliance is placed on mechanism, so long will there be the chance of a breakdown. The way out of the whole difficulty lies, of course, in the use of a storage battery; one competent to keep all the lamps going for a couple of hours appears to be all that is needed, and there is no longer any difficulty in getting such a battery. Mr. Edison is, however, much opposed to the adoption of secondary batteries, perhaps because he has not invented a good one himself. Mr. Edison is no doubt a great authority, but he will have to give way to the force of public opinion, or else he will be brushed aside. Absolute certainty of non-extinction is essential to electric lighting on a large scale, and the condition can only be secured by the aid of storage batteries.

At the Fisheries Exhibition little or nothing has yet been done. The engines are ready, and many of the dynamos are in place; but the old difficulty has cropped up. The electricians have, as usual, underrated the power required to drive their machinery. Messrs. Davey Paxman and Co. have provided about 1000 indicated horse-power; but there is every reason to believe that over 1300 will be required, and it is fortunate that the engines are substantial enough to bear the overdriving which will, apparently, be demanded. The pulleys provided have, in some cases, proved either too small, or the belts have been too narrow; and in one instance a wrought iron pulley became so hot as nearly to scorch the leather belt, owing to the slipping of the latter. The belts, too, have had to be tightened up so much that hot bearings have not been unknown. It would be more satisfactory for all parties if electricians would always ask for about three times as much power as they think they will need, instead of leaving, as they now do, a small margin of about 10 per cent. for contingencies.

As to the work actually done, we may say that nearly all the wiring has been finished, and it is hoped that a start will be made in a few days. Messrs. Siemens Brothers and Co. are lighting the main gallery, containing the exhibition of British sea fisheries, by means of Swan lamps, and the conservatory, adjoining the Royal Albert Hall, by four arc lights, each produced by a current of 32 ampères. The incandescent lamps in the main gallery have been supplied by the Swan United Electric Light Company, and give out a light of 20-candle power each, with a current of 46 volts and 1·34 ampères. The gallery is 800ft. long, and its roof is supported by eighty wooden arches, each having thirteen projecting points, on which the holders for the lamps have been fixed. At the far end a mirror is being put up to increase the effect produced by the lights by lengthening the perspective, and at the other end fifty-one lamps have been placed in the three arches forming the entrance to the permanent building. Altogether 1040 Swan lamps are distributed over the gallery. The necessary current is supplied by two Siemens alternate current machines—type W_0—and the leading wires are connected, so that lamps on alternate arches are worked by the same machine. The lamps in all parts of the gallery are intended to burn with equal brilliancy, a result obtained, without any regulating apparatus whatever, by a suitable arrangement of the circuits. A Siemens continuous current machine—type $S\,D_0$—produces the current for the arc lights in the conservatory, which are connected parallel, and are at a distance of about 420 yards from the machine. The lamps are of the ordinary Siemens pattern such as are used with single light machines, and have no shunt regulating coil, as required when lamps are worked in series.

SYNTHESIS OF ORGANIC COMPOUNDS BY THE ELECTROLYSIS OF ALKALINE AND ALCOHOLIC SOLUTION WITH CARBON ELECTRODES.

Messrs. A. Bartoli and G. Papasogli have recently published the results of their inquiries in this field, and they possess considerable interest. The electrodes which they employed were either graphite from different sources, retort carbon, or wood charcoal purified with chlorine at a high temperature. When water was employed as an electrolyte, a very strong battery —1200 Daniells—was employed to overcome the resistance. After the lapse of two days the water had acquired a brown colour, and a slight acid reaction, in consequence of which it conducted the current more readily, and the battery was changed for one of 100 elements, and after the lapse of ten days it sufficed to employ twenty elements, and this current was transmitted for another thirty days. After this time the water was almost black in colour; the carbon electrodes, which weighed about 500 grammes, were completely disintegrated, and the bottom of the vessel was covered with a layer of thick black pulverulent matter. In the liquid could be recognised mellitic acid and the derivatives of this acid, for instance, hydromellitic acid, pyromellitic acid, and hydropyromellitic acid. This acid occurs in combination with alumina, as a crystallised mineral, mellite or honeystone, in the brown coal of Artern, in Thuringia, and at other localities. And the acid was a few years ago prepared artificially by the action of potash permanganate on charcoal. At the bottom of the vessel, besides the broken-up pieces of graphite, was found a black substance, which is soluble in warm water and in alkalies, but is not taken up by the mineral acids and by other solvents. The authors have called this mellogen, because when oxidised it yields acids of the benzo-carbon series. Pure mellogen is solid, black, highly lustrous, soluble in water, alkalies, and sulphuric mono-hydrate, but throw down again from that acid by the addition of water; it is insoluble in ether, alcohol, chloroform, carbon disulphide, benzol, &c. It does not melt, is burnt with difficulty, does not crystallise, and exhibits a good array of colours. Its aqueous solution is thrown down by acids and mineral salts. These precipitates consist, as a rule, of pure mellogen; only those thrown down with the salts of copper, lead, and baryta, are true compounds. The most remarkable property possessed by this body is that it readily combines with oxygen, and, as already stated, forms acids of the benzo-carbon series. If a watery solution of mellogen be exposed to the air it becomes acid, and mellitic acid is formed. The best oxidising material is sodic hypochlorite, which is without action on graphite and retort carbon, which readily dissolves mellogen with a great disengagement of heat. Mellogen dried at ordinary temperature loses water at 130 deg.; between 130 deg. and 170 deg. no further change is noticed; at higher temperatures water is again given off, and the whole is lost. The analysis of mellogen shows it to have the formula $C_{11}\,H_2\,O_4$, and the constitution of the barytic salt is shown to be $C_{11}\,H\,Ba\,O_4$. If in place of distilled water an alkaline solution—hydrate or carbonate—be used as an electrolyte, there is always found after a few days a considerable quantity of mellitic acid and allied bodies, but very little mellogen. On the other hand, by employing acid electrolytes—sulphuric acid, nitric acid, hydrochloric acid, formic acid, acetic acid, and oxalic acid—the first-mentioned products are only sparsely found. The mellogen, on the other hand, is very plentiful. With phosphoric acid another result is obtained, for in this case the mellogen combines with the phosphorus to form phosphor-mellogen. The gases escaping from the poles were examined; at the negative pole there was always a development of large excess of hydrogen, at the positive pole a mixture of carbonic acid, carbonic oxide, and some oxygen. Phenol—carbolic acid—dissolved in potash, when treated in the same way, was almost completely converted into a substance which remained dissolved in the alkaline liquids; it is insoluble in acids, ether, and benzol, soluble in carbon disulphide, is black, uncrystallisable and infusible. Analysis gave the numbers C = 66·01, H = 4·18, and O = 29·81. Copper solution is reduced by this body, which, when boiled with acid water, splits up into two substances.

EXPLOSIVE ALLOYS OF ZINC WITH METALS OF THE PLATINUM GROUP.

A long and interesting research carried on by H. Sainte-Claire Deville and H. Debray on this subject has, since the death of the former, been completed by Debray. The compounds of osmium cannot be separated mechanically. If one endeavours to break them up in a steel mortar the pieces of osmium-iridium penetrate the steel but do not break. If we melt the alloy with from twenty-five to thirty times its weight of zinc, and heat the mixture for some hours at a red heat, and then more strongly to volatilise the zinc, there remains a spongy very friable mass, which is readily and completely attacked by a mixture of barium nitrate and barium peroxide—a material employed by the author for the oxidation of osmium and iridium—and is then easily soluble in acids. As baryta is afterwards easily separated from solutions the analysis of osmium-iridium alloys is rendered a very easy matter in this manner. What part the zinc plays in this reaction cannot be explained by the researches hitherto made; but the carrying out of the experiment is in this wise. The zinc is melted at a red heat and the osmium-iridium is then let down into it. A great development of heat is the result. The fused mass is to be kept at the temperature for from five to six hours, and after it has become cold the regulus is to be treated with dilute hydrochloric acid, which dissolves the zinc easily, while a black graphite-like mass remains, containing all the noble metals of the osmium-iridium alloy. The greater part of the iron present dissolves with the zinc, but a considerable quantity of the zinc remains combined with the two noble metals, and this quantity it is not possible to remove from them by any further treatment with acid. The residue, well washed and dried at 100 deg., evolves a feeble smell of osmic acid. When heated to 300 deg. it rapidly takes fire, almost with explosion, and gives off a considerable quantity of smoke, which consists of zinc oxide and osmic acid. As this combustion of the alloy also takes place in vacuo without any disengagement of gas and without any formation of zinc oxide or osmic acid, it must be assumed that at 300 deg. a great change of condition, involving a great evolution of heat, must take place. In the air these changes are immediately accompanied by the combustion which increases the development of heat. This residue is only partly attacked by concentrated nitric acid and *aqua regia*; it is readily and completely oxidised if placed in a crucible with a fused mixture of potash and potash nitrate. In a similar way it is oxidised when heated with a mixture of anhydrous baryta and barium nitrate. Osmium simply dissolves in zinc, and after testing the fused mass with acid it remains unchanged. Palladium and platinum yield alloys which when heated in vacuo form no isomeric modification. Rhodium, on the other hand, and especially iridium and ruthenium, combine with the zinc with a lively development of heat, and if these compounds are afterwards treated with hydrochloric acid, there remain residues which, when heated to 300 deg., pass over into an isomeric modification, the passing over being accompanied with a great evolution of heat. Before the development of the heat the black residues are more or less acted upon by *aqua regia*; after the development they have lost this property, and possess a metallic appearance. The thermal phenomenon, which accompanies the change of condition of the residue containing iridium, is so distinctly shown that it can be used to discover the presence of small quantities of iridium—say, from 1 to 2 per cent.—in platinum. To do this the platinum to be examined has to be melted in zinc, the alloy to be treated with dilute hydrochloric acid, the dried residue to be heated in a platinum dish to 300 deg., when iridium, if present, glows at different points of the mass. Ruthenium and rhodium exhibit similar appearances. Osmium is then the only platinum metal which, when fused with zinc, does not retain some of it, and thus the action of the zinc on the osmium-iridium alloy is readily explained. If the heat which is developed by the combination of iridium with zinc is greater than that developed by the combination of iridium and osmium, then, according to the law of thermo-chemistry, the compound of osmium and iridium will be destroyed by zinc. Osmium dissolves and can crystallise in the excess of the other metal. Iridium and the remaining metals, on the other hand, are in combination with the zinc. The residue of the action of hydrochloric acid on the alloy contains an excess of zinc from the above-mentioned explosive compound.

THE DISTRICT RAILWAY VENTILATORS.

The District Railway Company has published a statement with respect to the much talked of ventilators, and says that in deference to the complaints made three years ago the company sought and obtained powers in 1881 to construct ventilators in public streets and open places subject to the details of design and locality being settled by an arbitrator to be appointed by the Board of Trade. After a subsequent costly inquiry entered into before this arbitrator and the Metropolitan Board of Works and City Authorities, the award was made early this year, and the company proceeded at once to construct the ventilators in accordance with it and the design accompanying it. The company's statement purports to meet several objections made by the public to the ventilators, and first answers that which says that ventilation was only needed because coal and not coke is used in the company's engines. To this it is answered that ventilation was required, owing to the presence of carbonic acid gas and sulphurous acid gas, "both of which, as is well known, are emitted from coke in a much larger measure than from the coal used by the company, and purposely selected for its remarkable quality of smokelessness." The accuracy of this answer may be questioned, for, unless very poor coke is used, the sulphurous acid given off will be less than from almost any coal, and the carbonic acid given off will be in proportion to the carbon burned, and the decrease in favour of coal will only be that due to the very small quantity of hydrogen contained in smokeless coal. The imputation as to the sale of land by the company which would have afforded the means of ventilation without ventilating into the public streets, seems to be fairly answered and refuted, though it is acknowledged that an open ventilation in Tothill-street was closed, and the tunnel connected to the Aquarium chimney shaft, a plan which it is stated has failed. The narrow bridge which has recently been built at Westminster station was built under legal obligation for the accommodation of property on both sides of the line, part of which has been sold by the Metropolitan Board of Works. The greater part of the remainder of the statement is to show that the ventilators were necessary for the comfort of the passengers, and that they are successful. Now we have not thrown any doubt on the probable success of the ventilators if built, but we have objected to the insufficient use of condensing water, the use of coal instead of coke, coke of a good sulphurless quality, and to the employment of stock of a much heavier nature than is required, which has made them necessary. As we dealt with this matter in our impression for the 9th March, we need not dwell upon it here. To show that the ventilators act as such, and permit the escape of a large quantity of vitiated air, and the ingress to the tunnel of a still larger quantity of fresh air, the company has caused to be fitted to the ventilator between the Aquarium and the Westminster Palace Hotel, a number of anemometer vanes or wheels, which by the aid of gearing and contact make-and-break arrangement are connected with an electric recorder placed in the Aquarium. These anemometers show that during the approach of a train from the last station the quantity of ejected impure air is very large, the vanes moving at an increasingly rapid rate until the train reaches and passes the ventilator, when the vanes gradually stop, and then suddenly as the train passes the ventilator commence to run at a very rapid rate in the opposite direction, and the relative velocities at which the vanes revolve in the two directions are such that it is shown that the quantity of air admitted at the ventilators is greater than that ejected there, and that the quantity admitted or drawn in by the passing trains at the several ventilators, supposing them all to act as efficiently as that opposite the Aquarium, is, according to the statement, about 20 millions of cubic feet per hour. The result of this is, it is said, that the quantities of sulphurous acid gas and carbonic acid gas are reduced by over two-thirds, as shown by analysis of the atmosphere of the tunnel with the ventilators closed and open. Whether so large a difference is to be found in all parts of the ventilated tunnel is not clear, but it is only necessary to watch the ventilators to see the vitiated air leaving them in considerable quantities as a train approaches, while the quantity of fresh air admitted is undoubtedly very large—at least it is so at the ventilator opposite the Aquarium. The company's statement enlarges on the advantage which this ventilation secures for the very large number of passengers on its line; but the fact that the ventilators improve the condition of the atmosphere of the tunnel does not remove the objection that they would not be necessary under proper working arrangements.

TECHNICAL JURIES.

Our readers, like other people, probably have their misfortunes, among which law suits, when they occur, may be allowed a prominent place, and for engineers when they go to the courts on professional matters, the proverbial uncertainty of the law is intensified by the very subject of their disputes. In other words, when scientific matters are in question, the tribunals at present available do not afford a satisfactory settlement. If purely abstract science had alone to be considered, the absurdity of the present system would long ago have been manifest, and the process of law which puts the decision into the hands of a jury of merchants and shopkeepers, or leaves it to a judge who knows only as much of science as he does of art and medicine, would long ago have been abolished. But litigation when it commences is generally in one shape or other on some claim for money; the law prescribes a certain procedure and method of pleading, and no other machinery is available than that which serves for a disputed right-of-way or for an unpaid milliner's bill. Engineers, manufacturers, patentees, or others, whose avocations make them familiar with the nomenclature and processes of their business, hardly realise till they come into court the ignorance of the judge, counsel, and jury on the very elements of the case, and the hearts of suitors sink within them when they realise by the questions put to witnesses, by the statement of the counsel, and the elucidation offered by the judge to the jury, how small is the chance of the case being fairly tried on its merits. There are, it is true, brilliant exceptions, but these are seldom met with save when important cases are being tried. Such want of knowledge leads too often to a wrong decision, for counsel venture on assertions far more audacious and full of fallacy than they would dare to do on matters within the ken of the jury, and unfortunately are frequently able to enlist the aid of expert witnesses who presume on the want of knowledge of their audience, and confirm the fallacies of counsel in a way which they would be ashamed of doing before a jury of their professional brethren. For the above reasons we welcome any sign of a remedy, and we are glad to draw attention to the action of the London Chamber of Commerce, a body recently established under influential management, and which is striving to organise new systems of procedure. The first attempt is towards properly organised courts of arbitration, which shall deal with the disputes of different trades in a more satisfactory manner than is done by the so-called arbitration at present adopted; but from a communication made to the chamber by Mr. Ewing Matheson, C.E., one of its members, we see that the special need of a procedure for technical questions is also under consideration. It is evident that there is in London a large enough class of scientific persons, traders and manufacturers as well as professional men, from whom could be drawn jurymen and assessors able to arrive at right conclusions in technical disputes. Such classes would share so much in the advantages of a new system when their own interests were concerned, that they could scarcely object to give their services when called upon to settle the disputes of others. The establishment of a proper system and the arrangement of its details will obviously demand much care and deliberation, and we are by no means prepared to admit that there is as yet any very practicable suggestion before the public.

BRAKE SUCCESSES.

It is one of the peculiarities of the brake question that the better the brake works and fulfils the object for which it has been applied, the less one hears about its virtues. As a rule we have to wait for a serious accident arising from exceptional circumstances to find that the damage was greater or less according as the train was fitted with this or that form of brake, or with no brake at all. Three instances have recently occurred in which the quick action, so remarkable in the Westinghouse brake, has been the means of saving life and property. On the 31st ultimo, as the 8·50 a.m. train from Brighton to Portsmouth was nearing Portsmouth town, the engine driver observed a detachment of artillery passing the level crossing close to Port Creek Junction, some 60 or 70 yards in front of him. The instant application of the Westinghouse brake, with which every train on this line is now equipped, brought the train to a stand, the engine just grazing one of the artillery wagons, and doing no damage either to men or horses. On the 2nd instant another escape occurred on the same railway under peculiar circumstances which might have ended in a terrible death. As the 8 p.m. train from London to Newhaven was approaching Newhaven Harbour station, the driver saw a man upon the line, who it turned out had got his foot fast between the rails of a switch. The train was again brought to a stand by the Westinghouse brake only 2ft. from the terrified man, whose position was certainly not to be envied. The loss of a second, or even half a second, in the application of the brake would have been fatal to the trespasser. Our third illustration is from Scotland, where an accident of an alarming character occurred on the 14th instant. When the 11.10 a.m. train from Bervie to Montrose, on the North British Railway, was about 200 yards from Lauriston station, the engine suddenly left the metal dragging with it three or four carriages. The permanent way was displaced and the passengers shaken, but none of them sustained injury. The report adds that but for the timely application of the Westinghouse automatic brake the circumstances would have been very serious, as there is a steep embankment near the spot. No doubt incidents similar to the two first mentioned are frequently occurring without anything being heard of them, and it would be well if there were a system of returning successes as well as failures to the Board of Trade.

IRON AND STEEL RAIL EXPORTS.

The return of the Board of Trade of the exports of iron and steel rails for the first five months of the present year is one that proves conclusively the decay of our own iron rail trade. In the five months we exported only 13,379 tons of iron rails; the quantity for the corresponding period of last year being 31,000 tons, and that for the same period of the preceding year being still greater. The falling off is most marked in the exports to the United States, and we now send very few iron rails to any one country. But whilst this has been the case, the steel rail exports of the present year are above those of the same period of the past year. The exports of steel rails for the first five months of the present year were 313,485 tons, an increase from 288,667 tons for the corresponding period of the past year, and a still larger increase on the quantity for the preceding year's period. There was a decline in the tonnage of the steel rails sent to the United States this year, but to most of our other large customers there was an increase. The falling off in the exports to the United States was most marked, but the enlargement from Australasia, British India, and British North America more than counterbalanced it, with that of the increase—a very large one—to the countries that are not specifically named. A very considerable increase is shown in the exports of steel rails to Sweden and Norway, but none have been sent this year to Russia. Still, so far as the steel rail trade is concerned, there is nothing in the returns to discourage, but the contrary, for we are extending the area over which we sell our rails, and this is one of the facts that is of the utmost importance. The price of the rails is low, lower than it was a year ago, but as against this must be remarked that there has been a considerable reduction in the cost of the pig iron used, especially where this is hematite. The condition of the trade in some things is not so good as it was a year ago, but there are orders in hand that will take some time to work through, and in that period, with cheap production and an enlarged area of sale, there will be probably an addition of moment to the orders that the manufacturers now have.

AMERICAN PATENT FEES.

In the United States only a single invention can be included in a specification, and it is very often extremely difficult to determine whether an inventor has attempted to get in two or more. The examiners, however, as a rule, settle such questions by not giving the inventor the benefit of the doubt. The operation of the law places the American patentee at a considerable disadvantage. For example, on February 5th in the present year Mr. Albert H. Emery, of New York, took out no fewer than nineteen patents for dynamometers, weighing and testing machines. Taking the cost in fees at £7 each only, we have a total of £133. But the whole could have been included in a single specification in this country, and Mr. Emery would have obtained protection for three years for £25 spent in Patent-office fees. It is much to be desired that the United States system should not be adopted in future British patent legislation. If it be, inventors will often have reason to regret that the present law had been altered.

LITERATURE.

The Student's Mechanics. By Walter R. Browne, M.A. C. Griffin and Co. 1883.

Mr. W. R. Browne wrote in 1881 a series of papers on "The Foundations of Mechanics," which appeared in The Engineer. The present volume is the result of Mr. Browne's re-study of theoretical mechanics initiated at that time. The papers published by us proved that the writer took very keen interest in the subject, and was determined not to spare himself the trouble of thinking as much and as long as might be needed in order to get at the root of the matter. He is convinced that mechanics is a purely deductive science, say like logic, because logic is the typical deductive science, and accordingly believes that we have only to think hard enough to obtain the whole of mechanical knowledge, provided, of course, that we always think correctly, that is, logically. This we think a somewhat dangerous doctrine, as it, at the very least, obscures the recognition of the principle that all mechanical science is founded on experimental and observational evidence. However, Mr. Browne states that the first principles are thus founded. But he seems to forget that so soon as mechanical science is weaned from the written page of the student, and becomes something real and concrete with practical application, that new experimental constants are required at every turn. For instance, it may be an interesting and important problem in mechanical science to calculate the strength of a beam against breaking. So long as the student cares only for the formal solution of his problem, it may be very convenient and very easy to write certain letters of the alphabet to represent certain data, values that are needed to form his equation. This may, perhaps, be all that the pure mathematician desires, but until these data are found by experiment or otherwise, the equation has no real concrete application or even meaning, and, in fact, forms no part of physical science. We are of opinion, and Mr. Browne agrees with us, we believe, that mechanics, whether theoretical or applied, is not simply pure mathematics. At every point, in fact, there is a new appeal to our physical experience.

The book too often departs from simplicity of statement, with the result of making simple things appear difficult. For example, what is the advantage in describing "motion" as "a condition of bodies in which they are continuously changing their position in space," instead of as simply "continuous change of position?" On the other hand, in places we find that a fancy for neat symmetry leads the author entirely astray. Thus, nothing could be prettier than the following subdivision of mechanics:—(1) Kinematics, the study of motion apart from force; (2) statics, the study of force apart from motion; (3) dynamics, the study of motion and force together." But (2) gives an utterly fallacious idea of force, it being really utterly impossible to divorce the consideration of force from that of motion. In physical science there is no other meaning which can possibly be given to "force" than the rate per minute, or per second, or per hour, at which momentum—that is, quantity of motion—is transmitted from one portion of substance to another. Because opposite rates may co-exist and balance, so that the resultant exchange of momentum may be zero, is no justification for imagining that these rates of exchange or forces can be studied apart from the idea of motion. No such abstraction is in any real sense at all possible.

We are afraid that much of the same sort of confusion of ideas pervades the book. Thus we find a paragraph headed "Measurement of Motion," wherein the only subject referred to is velocity—which, in mechanics, is quite different from motion. The next paragraph describes the "Measurement of Forces," without a preliminary word of explanation regarding mass or momentum! It is explained that forces are to be measured by the accelerations of velocity they produce (!) with the mysterious proviso that "the things they act upon must be equal." Further explanations regarding "force," of a still more astonishing nature, are found on page 12, where we are told that "the forces of nature never cease acting; . . . . the symbol for time does not enter into the expression." To make room for a preconceived idea, the compressive stresses between bodies impinging on each other are put aside as not *forces* but *impulses;* and moreover we learn that "these cases of discontinuous forces are so (discontinuous) only because they have been specially so arranged by the power of man." Mr. Browne happens, for the moment, to think of "the blows of a hammer on an anvil," and forgets to think of the fall of rain-drops on the ground, of the fall of fruit from a fruit tree, of a wave on the seashore, or of an avalanche from the mountain side. Is the pressure of wind against a bridge "constant in time," or is wind pressure not a "force of nature?" Electro-magnets are certainly for the most part "so arranged by the power of man," but is the attraction of an electro-magnet not to be counted a natural force, simply because it is called into existence and thrown out of it again? After explaining forces, the author devotes a chapter to matter, the reason for this arrangement being that according to this treatise matter is composed of force. It is boldly asserted that the mass of a body is proportional to the number of points in it towards or from which attractive or repulsive forces radiate. Of course, this is abandoned as a practical method of measuring mass, owing to the impossibility of counting the number of such points; but we may notice the excessive daring that hazards this statement without hesitation or qualification.

We are heartily sorry not to be able to speak more favourably of Mr. Browne's book, or to express more agreement with his peculiar ideas. In the more straightforward strictly mathematical parts of the book we should certainly find more to praise, although we regret to say that we notice many pieces of fallacious reasoning scattered throughout the pages. But few, if any, of these algebraical portions are original, and Mr. Browne himself says that the only special claims he puts forward for the book are the completeness and thoroughness with which fundamental principles are explained and discussed. It is on this portion of his work, therefore, that he challenges criticism. We regret that ours must be adverse. The book finishes with a collection of axioms, definitions, and laws, and with an appendix of examples. This latter may be found useful to the student.

ROBERT GRIFFITHS.

We regret to announce the death, on the 16th inst., at his residence in Ledbury-road, Bayswater, of Mr. Robert Griffiths, "the father of screw propellers," as Captain Bedford Pim once called him. Mr. Griffiths was the son of a farmer near Bodfari, a parish in the vale of Clwydd, North Wales, where he was born December 13th, 1805. At a very early age he began to display a decided mechanical turn, and he was taught the trade of a carpenter. After working for some time at Rhyll, he removed to Birmingham, where he found employment as a pattern maker, but in a short time he was enabled to start in business for himself as a machine maker. In 1835 he took out a patent for a machine for making rivets, screw blanks, and bolts, and in the following year he patented, in conjunction with John Gold, a very ingenious machine for grinding glass. In 1836 he appears as the patentee of a nut-making machine, and in 1845 he patented another machine for making bolts, spikes, and rivets. The bolt and nut machines were highly successful, though the inventor himself, as often happens, failed to reap any very substantial benefits. It is stated that a Mr. Alcock, who took the rivet works when Mr. Griffiths left, made no less than £60,000 in a very few years, and we believe that we are correct in stating that Mr. Griffiths' inventions laid the foundation of the important nut and bolt industry of the town. From Birmingham he migrated in 1845 to Havre, where he started an engineering workshop and ironfoundry in conjunction with a Mr. La Bruyère. The concern prospered for a time, and some work was executed for a railway then in progress in the neighbourhood. Political troubles caused the business to fall off, and eventually the works were closed. Whilst at Havre his attention became directed to atmospheric railways, from which great results were expected at that period, and he took out two patents in 1845 and 1846 respectively, relating to the subject. He was associated in these ventures with the late Mr. George Hinton Bovill, whose name is well known in connection with improvements in corn grinding machinery. We have now arrived at the time when Mr. Griffiths commenced to investigate the subject with which his name is indissolubly connected, the improvement of the screw propeller, his first patent being dated September 13th, 1849. We understand that some of his early experiments were directed to the determination of the loss of power which would ensue by increasing the size of the boss for the purpose of giving additional strength. To his surprise he found that no such loss as he had anticipated took place, and this led him to a discovery which was totally opposed to all the then received notions. The experiments were made in conjunction with Mr. Bovill, who, in July, 1852, read a paper on the subject before the Institution of Mechanical Engineers in Birmingham. Instead of continuing the blades of the propeller down to the shaft, and keeping the boss as small as possible, one-third of the diameter was filled up by a sphere. In the experiments which Mr. Griffiths and Mr. Bovill made it was ascertained that the centre part of the blade of the ordinary screws absorbed 20 per cent. of the power, without having any propelling effect, in consequence of that part of the blades—especially in coarse pitched screws—being nearly in a line with the shaft, the effect being when working to hurl the water off by its flapping and centrifugal action at right angles to the shaft, and seriously disturbing the more solid water upon which the more effective portion of the screw should act. Further improvements in the screw were embodied in two patents granted in 1853.

Shortly after this patent was taken out, Mr. Griffiths left Havre and settled at Bristol, where the first trials were made with the improved propeller. It was also tried in London and at Liverpool. In March, 1853, experiments were made by the Admiralty at Portsmouth with the Royal yacht Fairy, to which one of the new screws was fitted. In June of the same year the Peninsular and Oriental Company took the invention up, and made experiments with it on the Cadiz. The details of these experiments will be found in the *Mechanics' Magazine* of the day. As an instance of Mr. Griffiths' ceaseless inventive activity we may mention that whilst at Bristol he found time to devise and patent an electric hair brush and comb. About this time he was employed by Messrs. Swayne and Bovill, at Briton Ferry, to superintend the rolling of a particular kind of wrought iron chair or sleeper for a foreign railway in which they were interested. In 1853 he came to London, and for ten years or so he resided in Mornington-crescent, closely occupied with introducing and improving his screw propeller. His next move was to Chester, and thence, shortly afterwards to Rhual Issa, near Mold, where he became the principal proprietor of a colliery, and commenced the manufacture of paraffine oil from shale. This enterprise was not successful, being ruined by the large importations of crude petroleum from America, and Mr. Griffiths retired from the concern a considerable loser. He returned to London again and concentrated his energies on the screw propeller, his numerous improvements being duly recorded in the patent lists. During the later years of his life he turned his attention to methods of protecting screws; and his "protector" was tried on the Bruiser at Plymouth, in 1875, with very satisfactory results. It formed the subject of a Parliamentary paper in the following year. It consists of two concentric rings firmly attached, the larger one being in advance of the smaller. They are fastened at the top and bottom to the screw frame, so that the forward edge of the smaller ring is opposite the middle of the propeller. Experiments have shown that the efficiency of a screw propeller is increased by this "protector."

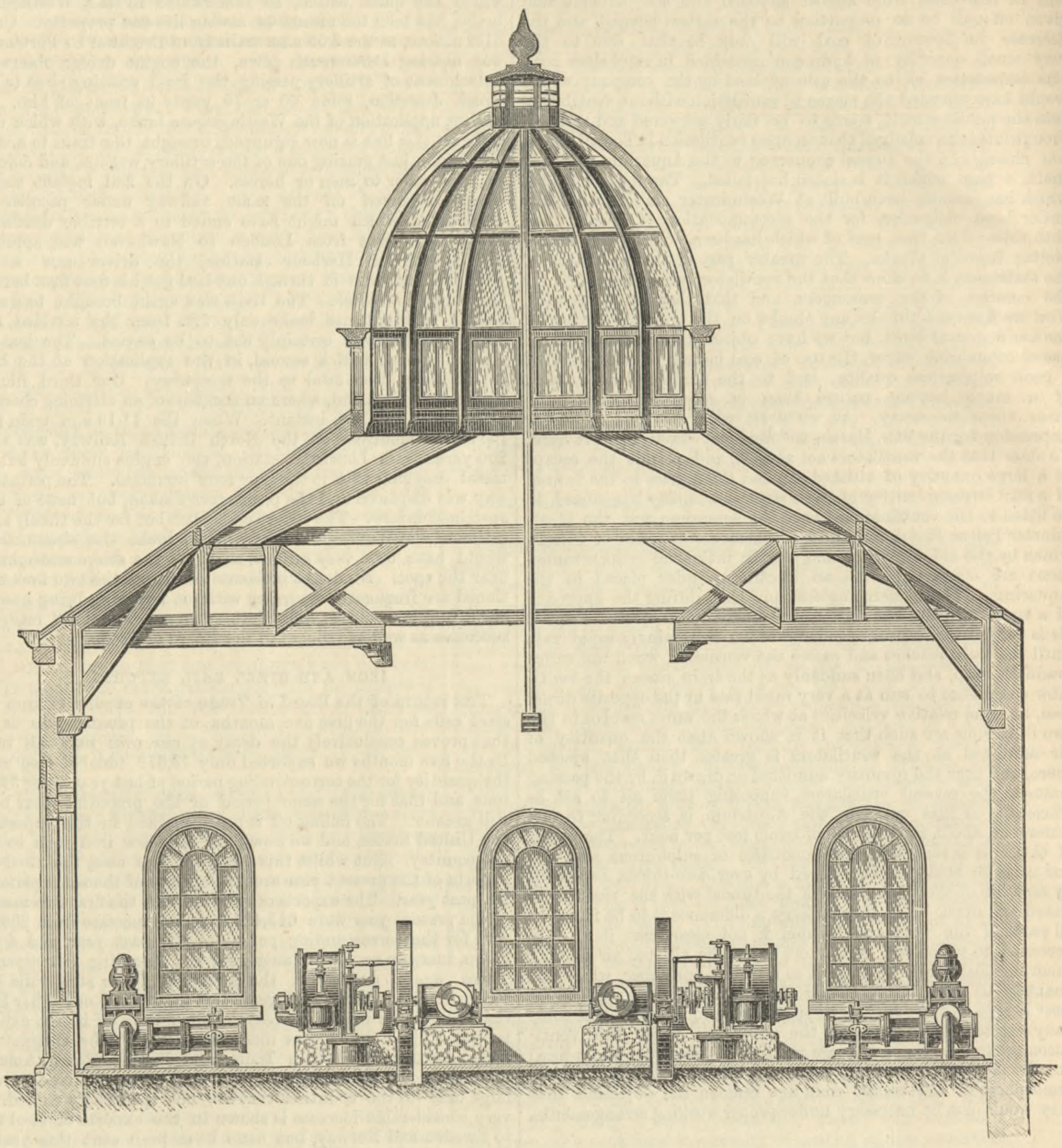
Mr. Griffiths has contributed several papers to various societies, the last of which was perhaps that read at a meeting of the Royal United Service Institution in April, 1881, on "Recent Experiments in Screw Propulsion." In that paper he enlarges upon the importance of placing the propeller a considerable distance aft of the stern post. He also wrote a pamphlet in 1860, entitled "The Screw Propeller: What it is and what it ought to be," and "A Description of Griffiths' Improved Patent Screw Propeller, with its Recent Improvements under Patent No. 319, February 20th, 1858."

Such is an imperfect and somewhat superficial sketch of the career of a very remarkable man, whose inventions have exercised an important influence upon the subjects to which they relate. It is to be hoped that a fuller record of his work may be compiled by those who have been more closely associated with him. Mr. Griffiths leaves a widow and a son, the latter of whom has been for some time connected with his father in engineering pursuits.

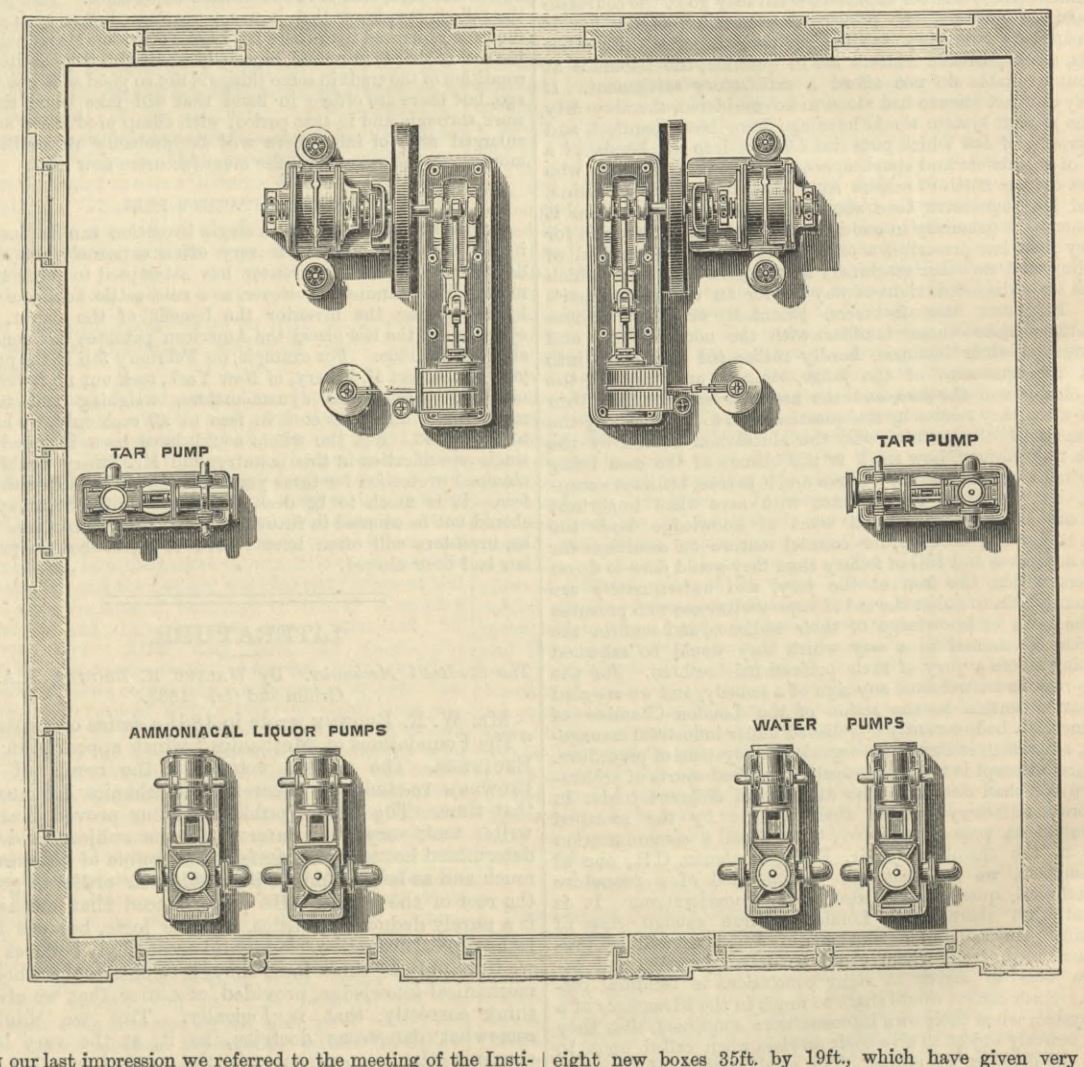
THE PATENTS BILL.—Yesterday — Thursday — afternoon the President of the Board of Trade received a deputation from the Council of the Institute of Patent Agents. Mr. Chamberlain was accompanied by Mr. John Holms, M.P., and Mr. Farrar, of the Board of Trade, and there were present, amongst others, the president of the Institute, Mr. J. H. Johnson; the vice-president, Mr. J. Imray, M.A.; Messrs. C. D. Abel, W. Brookes, W. Carpmael, W. Clark, A. V. Newton, W. Spence, W. Lloyd Wise, and G. G. M. Hardingham, hon. sec. The object of the deputation was to submit to Mr. Chamberlain's consideration some suggestions with regard to the Patents Bill which the Institute had adopted, based upon their professional experience, of the leading firms of patent agents in the United Kingdom. The points urged by the deputation were as follows:—That the head of the Patent-office should be a capable and accessible official; that, as the time of the law officers was at present so fully occupied as to impede seriously the progress of patent business brought before them, the duties proposed by the Bill to be assigned to them should be imposed upon the controlling authority of the Patent-office itself; that, as claims would often not be defined in a provisional specification, such absolute definition be, as at present, postponed to a later stage; that the question as to whether an application contains subject matter for a patent should not be a matter for the decision of the Examiner; that power should be given to an applicant or patentee to amend his claims if they have been injudiciously framed; that the Register of Patents should be maintained in as full a form as at present; and finally, a new clause was suggested to avoid the evil of letters patent granted to foreigners becoming invalid in consequence of the publication of their specifications prior to the grant of their British patents. Mr. Chamberlain assured the deputation that their suggestions should have his fullest consideration. He hoped to introduce into the Bill amendments which would meet all the points brought before him except the first two, which would practically be constituting a new court. The question of giving the Comptroller power to decide in the first instance, but subject to appeal to the Law Officers, should have his careful attention.

PUMP AND EXHAUSTER HOUSE, SHEFFIELD GASWORKS.

ELEVATION



PLAN



IN our last impression we referred to the meeting of the Institute of Gas Engineers at Sheffield. Amongst other places visited by the members was the works of the Sheffield United Gas Company, of which Mr. J. T. Key is the engineer. A short time since the company decided to remove three old purifying houses and erect new, the purifying plant being too small, having only $2\frac{1}{2}$ superficial feet area per 1000 cubic feet of gas made, instead of something like 10ft. superficial. The company therefore took down the three old purifying houses and eight boxes, erected a new house with revivifying floor above of over 1000 square yards, and eight new boxes 35ft. by 19ft., which have given very good results. The exhausters were also found to be too small for their work and worn out, and the engines and pumps the same—in fact, the engine-house and all it contained was condemned and taken down. These were replaced with a new house containing two combined engines and exhausters equal to 200,000 cubic feet per hour each, made and fixed by Gwynne and Co. The old pumps were replaced with six of Hayward Tyler and Co.'s steam pumps, arranged as illustrated by the annexed engravings. Two of these pumps are employed for pumping ammoniacal liquor, two for pumping tar, and two for pumping into a tank for the general supply of the works, which in winter produce six million cubic feet per 24 hours. The pumps have steam cylinders 12in. diameter and 12in. stroke, the pumps being 8in. diameter. The tar pump forces against a head of 50ft., and like the other pumps, lifts 12ft. It delivers about 6000 gallons of tar per hour, the speed being of course much less than when pumping water with similar pumps.

TABLES FOR RAILWAY ENGINEERS, PLATE-LAYERS, &c.

By C. BALDWIN.

THE following are the radii of some of the curves to be found on railways. The radii are in chains, &c., with their equivalents in feet.

Table No. 1 shows the ver. sin. or offset in the centre of a 66ft. chord. This table will be found useful in getting at the radius of a curve in order to give the required tilt to the outer rail. A 66ft. chord is taken in preference to a 100ft. one, on account of bulk in carrying; a 66ft. tape could also be used if the cord was not handy. Table No. 2 gives the ver. sin. or offset in the centre for bending a 30ft. rail. The London and North-Western Railway, Midland Railway, Great Northern Railway, Great Eastern Railway, North-Eastern Railway, and North London Railway, now all use a 30ft. rail, and the Lancashire and Yorkshire Railway and the London, Brighton, and South Coast Railway companies are adopting rails of this length. Table No. 3 gives the super-elevation of outer rail for the running of trains at different speeds. Fifteen miles per hour is taken as the average for goods yards, &c., twenty-five miles per hour for goods trains and on slow roads, forty miles per hour for ordinary passenger trains, and sixty miles per hour for first-class express trains. The super-elevation given should be attained at the tangent points of the curve and maintained the whole length, the outer rail being raised the required amount at each end of the curve by a grade of 1in. in 100ft. Some plate-layers only give three-fourths of the required tilt at the tangent of the curve, and the full tilt in the centre of the curve. It is also advisable to reduce the speed than exceed 5in. super-elevation on any curve. On sharp curves the gauge is increased by ½in.

Radius of curves in			Table No. 1. Ver. sin. for a 66ft. chord.		No. 2. Ver. sin. for bending a 30ft. rail.	Table No. 3. Super elevation of outer rail. Speed in miles per hour.			
						15	25	40	60
Ml's.	Ch'ns.	Ft.	Ft.	In.	In.	In.	In.	In.	In.
	3	198	2	9 7/32	7 3/32	4 9/32			
		200	2	8 29/32	7 1/32	4 1/4			
	3½	231	2	4 7/16	6 1/16	3 21/32			
		250	2	2 1/4	5 5/8	3 13/32			
	4	264	2	0 27/32	5 5/16	3 7/32			
	4½	297	1	10 1/16	4 23/32	2 27/32			
		300	1	9 27/32	4 11/16	2 13/16			
	5	330	1	7 27/32	4 1/4	2 9/16			
		350	1	6 23/32	4	2 7/16			
	5½	363	1	6 1/32	3 7/8	2 11/32			
	6	396	1	4 17/32	3 17/32	2 5/32			
		400	1	4 3/8	3 1/2	2 1/8	5 7/8		
	6½	429	1	3 1/4	3 9/32	1 31/32	5 15/32		
		450	1	2 9/16	3 1/8	1 7/8	5 7/32		
	7	462	1	2 5/32	3 1/32	1 27/32	5 3/32		
	7½	495	1	1 7/32	2 27/32	1 23/32	4 3/4		
		500	1	1 3/32	2 13/16	1 11/16	4 23/32		
	8	528	1	0 3/8	2 21/32	1 19/32	4 15/32		
	8½	561	—	11 21/32	2 1/2	1 1/2	4 3/16		
	9	594	—	11	2 3/8	1 7/16	3 31/32		
		600	—	10 29/32	2 11/32	1 13/32	3 15/16		
	9½	627	—	10 7/16	2 1/4	1 11/32	3 3/4		
1/8	10	660	—	9 29/32	2 1/8	1 9/32	3 9/16		
		700	—	9 11/32	2	1 7/32	3 3/8		
	11	726	—	9	1 15/16	1 5/32	3 1/4		
	12	792	—	8 1/4	1 25/32	1 1/16	2 31/32		
		800	—	8 3/16	1 3/4	1 1/16	2 15/16		
	13	858	—	7 5/8	1 5/8	1	2 3/4		
		900	—	7 9/32	1 9/16	15/16	2 5/8		
	14	924	—	7 1/16	1 17/32	29/32	2 17/32		
	15	990	—	6 19/32	1 7/16	27/32	2 3/8		
		1000	—	6 17/32	1 13/32	27/32	2 11/32		
	16	1056	—	6 3/16	1 11/32	13/16	2 7/32	5 23/32	
	17	1122	—	5 13/16	1 1/4	3/4	2 3/32	5 3/8	
	18	1188	—	5 1/2	1 3/16	23/32	1 31/32	5 1/16	
	19	1254	—	5 7/32	1 1/8	11/16	1 7/8	4 25/32	
1/4	20	1320	—	4 31/32	1 1/16	21/32	1 25/32	4 9/16	
		1500	—	4 3/8	15/16	9/16	1 9/16	4 1/32	
	25	1650	—	3 31/32	27/32	1/2	1 7/16	3 21/32	
3/8	30	1980	—	3 5/16	23/32	7/16	1 3/16	3 1/32	
		2000	—	3 9/32	11/16	7/16	1 3/16	3	
	35	2310	—	2 27/32	19/32	3/8	1 1/32	2 19/32	5 7/8
		2500	—	2 5/8	9/16	11/32	15/16	2 13/32	5 7/16
1/2	40	2640	—	2 15/32	17/32	5/16	29/32	2 9/32	5 1/8
	45	2970	—	2 3/16	15/32	9/32	25/32	2 1/32	4 9/16
		3000	—	2 3/16	15/32	9/32	25/32	2	4 17/32
5/8	50	3300	—	1 31/32	7/16	1/4	23/32	1 13/16	4 3/32
		3500	—	1 7/8	13/32	—	11/16	1 23/32	3 7/8
3/4	60	3960	—	1 21/32	11/32	—	19/32	1 17/32	3 7/16
		4000	—	1 5/8	11/32	—	19/32	1 1/2	3 13/32
		4500	—	1 15/32	5/16	—	17/32	1 11/32	3
7/8	70	4620	—	1 13/32	5/16	—	1/2	1 5/16	2 15/16
		5000	—	1 5/16	9/32	—	15/32	1 7/32	2 23/32
1	80	5280	—	1 1/4	1/4	—	7/16	1 5/32	2 9/16
		5500	—	1 3/16	1/4	—	7/16	1 3/32	2 15/32
	90	5940	—	1 3/32	1/4	—	13/32	1	2 9/32
		6000	—	1 3/32	7/32	—	13/32	1	2 1/4
1¼	100	6600	—	1	7/32	—	11/32	29/32	2 1/16

EARTH-SHOCKS IN THE BUKOVINA.—Austrian papers report that a mountain in the neighbourhood of Czernowitz, in the Bukovina, is manifesting singular symptoms of disturbance. The ground around its base, to the extent of over 1000 fathoms, has opened out in wide and deep chasms. Most of the houses of a village on the spot—Kuczumare—have fallen down.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents.*]

THE PROBLEM OF FLIGHT.

SIR,—Birds sustain and translate themselves in the air in two broadly contrasted ways. One method may be termed the active winged, the other, the fixed or passive winged. In the first, the creature employs muscular force to beat the atmosphere with its pinions, and in this way overcome the weight of its body and the friction of the air. Humming birds, meadow larks, quails, swallows, and multitudes of familiar birds are examples of this method. They are about us everywhere, can be seen at any time, and they can move in air either against the wind, or with it, or obliquely to it, in any direction, in either a horizontal plane, or a vertical one, or on any degree of inclination between these. They can also move in any of these directions during a calm, when there is no wind.

All birds can thus employ muscular force from within themselves to effect flight—the large as well as the small varieties; and this active winged feature has been recognised, commented upon, explained, treated experimentally with instruments of precision, and men have devoted themselves to imitate this method to effect the same purpose—that of travelling in the air.

The other method—that of the passive, or fixed winged—is where the bird does not employ muscular force, but with rigid extended pinions, in which there is no motion, sustains itself against gravity, and is translated in any direction, independently of the direction of the wind, or in a dead calm, in all respects—with a single exception—doing what can be done with active wings. They cannot stand in a fixed place during a calm. With this exception they perform all the movements which can be accomplished by active wings.

The birds habitually moving on fixed wings are of the larger kinds, such as cranes and vultures, and do not inhabit the parts common to man in great numbers as do the smaller, active-winged kinds. They become very shy where they are in contact with man, and only act in natural, unconstrained ways at great heights or in inaccessible places, where their movements are difficult of observation. Not so in their native haunts, or where they know man in some other *rôle* than as a destroyer. Here they are found in bewildering quantities. Their habits can be studied at leisure, and by the use of a little ingenuity which egregiously deceives, but does not injure, the feathered denizens, they can be made to exhibit all the peculiarities of the fixed-wing process with no less plainness and ease of observation than can be found with the active-winged birds. No one doubts the performances of the latter—their flight in all conditions of air, windy or calm, their rising, or falling, or passing in any direction at will; nor can any one doubt the performances of the fixed-wing varieties when seen under equally favourable circumstances. There is no more doubt about the one than the other; yet the latter is unrecognised by the scientific world, or only doubtfully admitted, while no one, so far as my knowledge extends, tries to imitate this method in artificial flight. There seems no use to continue this state of things. The facts belonging to the fixed-wing method should be no more doubtful than the other.

To get a full understanding of the whole situation a few words of a topographical character are needed. The coast of Southern Florida, bordering on the Gulf of Mexico from Tampa Bay to the capes, might be called a flat sand bank covered with a stunted growth of pine, palmetto, and mangrove trees, and bushes, totally destitute of hills. In the rainy season the water will stand over the whole country, generally speaking, from the bay to the capes entirely across the peninsula, the immediate banks of creeks and the Gulf beaches only excepted. There are no harbours. The mouths of the creeks are obstructed by long sand flats, while the coast waters are shallow, often at a dozen miles from land no more than as many feet in depth, while the bottom of clear sand is always visible. The coast is lined with long narrow keys, with passes between connecting the Gulf with the bays between these keys and the main land. These bays stretch out to many miles in width often, but in the main are less than a mile wide, and consist in sand flats covered a few inches at high tide, with meandering channels through them 5ft. or 6ft. in depth, interspersed with holes. Charlotte's Harbour is a fine sheet of water behind the keys of Gasparilla, and entered by the pass of Boca Grande, which carries 12ft. of water into the harbour, the deepest entrance on the coast south of Tampa Bay. Over these flats and through these tortuous channels the tide ebbs and flows through about 18in. in height, a mild elevation, typical of the whole country, for Southern Florida is violent in nothing. All these quiet waters are inhabited by a teeming multitude of fish. Fish in the creeks, in the bays, in the Gulf, and in the rainy season over the whole land. Small fish—from the egg up—in all stages. Mullet of two pounds when adult to porpoises of two hundred, stingarees, starfish, and a host of edible, poisonous, curious contrivances that swim the water, have here their abiding places. The human population is very limited. The land is sterile to all but air plants and a tough fibrous vegetation with small tops and prodigious roots; and unless one can live on fish, existence has its drawbacks. The climate is delightful at all seasons, and hence a state of things exists which might have been predicted, for the bird life is as multitudinous as the fish life, provided the creature is so made as to be able to catch a fish or steal one, or not being particular as to the freshness of its diet, could eat one found dead. Any bird endowed by nature with a pair of legs long enough to wade in a few inches of water, as the cranes and herons, or with feet webbed to the ability of swimming as the pelicans and cormorants, or that could dive upon a fish with a fair chance of capture, as the various fish hawks, or that could command the travelling resources of the air to steal a meal from some weaker creature, like the man-of-war hawk, or could eat a dead fish with preference for the savour of decomposition, like the turkey-buzzard, would be likely to live and thrive in a country like this; and so they do. In March they would select some bush-covered pond in the interior, build their nests by the hundred, and bring up an innumerable colony of young fish devourers for the next campaign. During the summer and winter they would select some isolated key surrounded by a mile or two of flats for a roosting place, and with endless jabber and squalling would assemble at nightfall and leave with the dawn to war on the finny tribes.

In addition to the supply of birds, the level country, the mildness of climate, and the scarcity of man, the atmospheric conditions were all that could be desired by one bent on observing the birds. For months continuously a dead calm would prevail at sunrise and last often until the middle of the forenoon, when a gentle breeze would set in from the Gulf, and continue into the night with varying intensity. In October would occur gales lasting a week, and during the winter the "northers" and "nor-westers" would give a lively wind for days together. Nothing could exceed the gentleness of these sea-breezes during the calm seasons. The whole body of the air seemed to move in one homogeneous mass, and even when the flow passed at the rate of ten or twenty miles an hour, it seemed less agitated by gusts and flows than I ever elsewhere experienced.

In such a country as this, one who was possessed by a lively curiosity to investigate the habits of soaring birds, and learn their secrets, might, in four or five years of pretty persistent effort, discover a good deal. In fact, a better locality could hardly be wished for.

In the array of fish-eating life above noted, two species were habitual dwellers in the air—the man-of-war birds and the turkey-buzzards. The others preferred to prosecute the business of their lives on *terra firma*, but could, with few exceptions, sustain themselves on fixed wings when occasion called for such action. Both of the former species were plenty all along the coast for three hundred miles, getting larger as they lived further south; the habits of the buzzards being the best for observation. These bird were often 7ft. in alar dimensions, weighed six or seven pounds, and exhibited about five square feet of surface. It will be seen that they were large enough to be viewed critically.

With these preliminary remarks, which time and space forbid continuing, let me go on to the phenomena exhibited by these soaring creatures, and omitting all special or unusual exhibitions, confine our attention to what can be seen almost any day, at any locality on the coast, from Tampa Bay to the Capes of Florida. A constant habit of the buzzards was standing over the inside beaches on fixed wings almost the entire day during a western breeze. One might say that the wind had an upward trend on approaching the shore. The land was certainly some 2ft. or 3ft. higher than the water, and the air at this point would have something of an upward curve. If the birds could only stand in one locality over the shore line it might indicate that they were assisted by this upward trend. But it is indifferent to them where they stand, either a hundred yards to sea or the same distance to land, or directly over the shore line 20ft. high or 200ft. high, or 2000ft. high made no difference at all in their movements. In time of still weather the supply of fish would become scarce and the birds hungry. I could always predict from their movement where a dead fish was cast upon the outer beach three miles away. The birds would become restless, until the most sanguine would start for the carcass; then another and another would go, and finally every one departed. How did they manage it? Vibrate their wings with increased velocity to overcome the friction of the wind as they moved against it? In no instance did they ever do so. They were floating in the air at heights of from 10ft. to 200ft.—say fifty birds—some directly over the shore line, some over the land, some over the waters of the bay. The wind was probably moving at the rate of ten miles an hour, and they had been in that same locality for five hours on motionless wings, partly flexed, as was their constant habit. The only movement made was to extend the wings to their full extent when they instantly darted into the wind with a velocity which carried them over the three intervening miles to the outer beach in as many minutes.

I have seen them start many hundreds of times, have been on the bay in various places and seen them pass, and have been on the beach in the vicinity of the carcass and seen them arrive, and until they prepared to alight their pinions were motionless, without an exception. Some of them would arrive at the same height as they stood when starting; some would start at high elevation, and slant downward; some would start and slant upwards, and, arriving too late, would return without a taste. It makes absolutely no difference to these birds what direction they go. I have seen them ascend perpendicularly upward to the height of a mile while facing a breeze, without once moving a wing, and move in all conceivable directions with indifference. The last birds to go in the above case were always in the greatest hurry when they did start, and their emotions getting the better of their discretion, and interfering with the automatic precision of their muscular tensions, they were in an instant capsized, and sometimes struck the water before being able to right themselves.

As the birds were preying on the fish, the latter were also eating each other, and the sharks and porpoises penetrating into the channels of the bay at high tide, made havoc with the smaller fry. Sometimes a wounded fish would seek a hole and there die, and in due course rise to the surface and be stranded on the flats at low tide. The buzzards would be in waiting for the water to recede, so as to give them a foothold. I have seen a hundred birds a mile from the nearest land standing on the breeze on fixed wings waiting for the ebb of the tide. I bore a remarkably good character with them, never disturbing them, assisting them whenever I could do so, and was on very good terms with them. I have waded under them when they were on food intent, and stood within 10ft. of them hundreds of times far out in the waters and flats of the bay. While there I have often witnessed other buzzards returning from the beach on fixed wings with the wind, and others going out to the beach in a similar manner against the wind, and others crossing at all angles and at all heights in the air. In fact, it was a rare thing to see a buzzard move its wings when it wanted to go anywhere. They could make far better time on fixed wings. But it made no difference in the travelling capacity of these birds whether there was any breeze or not, excepting that they could go better in a dead calm. I repeatedly mortified the flesh by getting out of bed with the first streak of light and posting myself near a dead pine, which served as the roosting place for a colony of some thirty of these birds for a number of years. They do not like to travel in the night, but will move early when a breakfast is imminent. Should they scent the morning air favourably, one by one they will leave the perch by the usual flapping of wings to get a start and some elevation, and then, stretching their pinions as usual, away they go with far greater velocity than against the wind. As usual, the last to go are in the greatest hurry, and mishaps are frequent. They will stretch their wings before attaining sufficient velocity, when they go down at once, and become active to get up again and get a fresh start. Sometimes after starting they take a bend downwards before getting the required velocity. I have often stationed myself beside a carcass to await their arrival in the morning. They came from every direction, and always in the same way on fixed wings. Some days of entire calm hundreds of the birds can be seen in the air on fixed wings in all directions. They do not stand over the beaches on such days, but lie upon the air by circling round and round, spending the entire day in one locality. Space will not permit me to note the transcendent feats of the man-of-war hawk. These banditti of the air are certainly splendid fellows, and rarely move their wings. I have every reason to think that they remain in the air for a week at a time without alighting. Their feet and legs are ridiculously small and weak, but they have a splendid development of wings and beak, and they steal for a living. I never saw one of these birds take a fish from the waters. The rear edge of their extended wings is longer in proportion to the weight of the bird and extent of surface than with any other species known to me, and their power over the air greater. They can be seen floating at the height of a mile over the waters of the bays two hundred days in the year, and I have never observed a wing motion while they were thus lying upon the air.

Now, I submit that these phenomena call for explanation, and for one adequate to the case. No supposed upward whirl of currents of air will do, for the phenomena of sailing are exhibited to perfection in days of dead calm. No hypothetical difference in density or in motion of subjacent strata of air will answer, for upon uncovering a carcass, the buzzards will swoop upon it from all directions, and all equally on fixed wings. Is the air then arranged on radial lines centreing upon a dead body, and is it so made up in reference to all carcasses? There need be no question in regard to the stillness of the air. On all days when there is no perceptible current the fixed wing process can be seen. On some of these days it is presumable that there is really no wind. On many of them a gas bag or hot air balloon would ascend thousands of feet vertically, while I have seen from the lantern of Egmont Light, at the entrance of Tampa Bay, buzzards passing to and fro on fixed wings fifty feet beneath me, when a handful of feathers thrown into the air would rest at the base of the shaft under the influence of gravity alone. There are some things about which there is no reasonable doubt—the multiplication table, for instance; and this thing of soaring seems to belong to this category. They can each be verified at will, and they always give the same results.

I have elsewhere given a solution of the whole subject of soaring which has up to this time stood secure against criticism. Independently of any theory of flight, however, there are certain facts which might be overlooked, but which only require to be stated to be admitted, and which make the paradoxical character of flight less marked. Take the case of a buzzard standing in one place in a breeze, one of the most common exhibitions of these birds on the coast of Florida. Assume that the air is moving in a horizontal plane at the rate of ten miles an hour. One matter to be thought about is the astonishing delicacy of the equilibrium. Whatever the factors may be which are concerned in flight, it is evident that the force of air in motion is utilised by the bird mechanism to counteract gravity and its own friction on the surfaces exposed to it, until they precisely balance each other. A certain condition of weight, position, inclination, extent of surface, shape of surface, &c., on the part of the bird, may be assumed to be the maximum for flight. This maximum would serve to carry the creature through the air with the greatest possible velocity. In the case in point the maximum is departed from just enough to support the mechanism in a given current of air in one place. Now the maximum is evidently a differential result of the operation of many factors, and the movements of the bird are determined by the composition of these factors. If the composition was a maximum against gravity, and to precisely balance friction, the course of the bird would be vertically upwards. If the composition was a maximum against friction, and to precisely balance gravity, the course would be horizontally against the air. And so of every direction of motion. That the bird could project itself upward on fixed wings is no marvel, provided its ability to stand in wind at all is conceded. How much more force does it take to bring a cork to the top of a vessel of water than it does to get it half way to the top? As the bird stands in the supposed case, it has no weight, and no friction. What I mean is this; suppose the bird to be deprived of all sense except the automatic ability to preserve equilibrium, and that you proceeded to apply a balance to ascertain its weight. How much would it weigh? Suppose that you applied the balance to drag it against the wind, how much power would it take? Would the force required in either case be great enough to be measured?

Suppose that the atmosphere reached to the height of a hundred miles, and that it was flowing in a perfectly homogeneous current through its whole extent with the same density and velocity, and in all respects identical with its condition at the position of the bird, and that you placed your finger under the creature and pushed it upwards with the force of a single ounce, would it not be carried at once to the top of the atmosphere? Bear in mind that the phenomena here presented are totally different from that of a fish floating in water, a balloon in air, or of a body of any kind immersed in a fluid as heavy as itself. These are illustrations of statics, while the floating bird is a very interesting instance of dynamics, of a body in the grasp of pure force, from which weight and friction have been cancelled.

Permit me to ask another question. Given the bird floating in the wind as above described, then suppose it passes to the front, say ten miles, how much greater expenditure of force is required to effect the translation over the ten miles than to sustain the body in one place without motion? Does not the application of distance, as measured over the earth's surface, to the phenomena of soaring birds lose its significance?

Again; is not the statement of the bird standing in the wind in this case a statement of the entire question of flight on fixed wings? In every instance, in all conditions of flight, it is essential that the wind be blowing against the bird. Whenever the bird moves with the wind it travels faster than the air current. When it moves in still air the wind is virtually blowing against it. To *travel* in still air requires conditions identical with those for *standing* in a breeze.

In all the observations of soaring birds made by myself through many years in a large scope of country, and upon very many different species, I have never seen the phenomenon of a bird standing in one place on fixed wings in a calm. Neither have I ever seen a bird moving on fixed wings in air, when the wind was not blowing against it, without it was either losing speed or descending. Now there seems to be no difference in these two statements; to wit, first, the phenomena of soaring is the result of wind moving upon an inclined plane; and secondly, it is the result of inclined planes moving on air. I. LANCASTER.

Chicago, Ill.

LOAD AND STRAINS ON COAL WINDING ROPES.

SIR,—I have pleasure in giving the following facts in corroboration of the statements by Messrs. Stokes and Longden, quoted by you on page 451—June 15th.

Some years since I had a winding rope broken about 3ft. above the cap, in the act of raising the loaded cage from the props; in fact the cage was raised, and fell about 2½ft., as nearly as could be estimated. The weight of cage, tub, coal, and chains, with the cap and piece of broken rope, would be 75 or 76 cwt.; the weight of rope suspended in the shaft 32 cwt.; total, 108 cwt. The rope was a flat one, of iron wire, tapering from 4¾in. to 4¼in. wide, giving a breaking strain of 60 tons and 50 tons, and a safe working load of 136 cwt. and 112 cwt. at the upper and lower ends respectively. It had only been in use a few weeks, and there was no sign of any flaw at the point of rupture. After the torn end was cut off, and the rope re-capped, it continued to do its work satisfactorily for the full average life of the ropes at that pit. The engine, although a single cylinder one, was remarkably easy to handle, and the engine-man one of the steadiest and most skilful that I have known. The rate of winding, though smart, was not excessive, the run of 202 yards being made in 30 seconds, and the three-decked cage changed in 30 seconds; or, allowing for occasional delays, say 55 runs per hour.

At first sight the rope might have been expected to break at the top end, where the actual weight to be lifted was nearly 80 per cent. of the theoretical safe working load, rather than at the bottom end, where the weight was only 68 per cent. of the theoretical safe load; but when it is remembered that the 32 cwt. of rope is already in rapid ascending motion before the "snatch" comes to start the 76 cwt. of cage, &c., into motion, it is apparent not only that the rope actually did break where the severest strain came upon it, but also that that strain is very much nearer to the actual breaking strain than is commonly supposed.

A mere record of facts, such as the above, is not of much value unless it leads to the suggestion of some improvement in the appliances, or in the method of using them, calculated to obviate similar accidents in future. One such suggestion, and the most obvious, is the substitution of steel for iron ropes, giving, with a rope of the same weight, an increased strength of some 50 per cent.; but of course at a considerably increased cost. To employ a stronger, and consequently heavier iron rope, would have the effect of striking an up-hand blow with a heavier hammer than before. Again, it is doubtful whether, for pits of moderate depth, the advantages obtained by a tapered rope are not purchased too dearly by the weakness at the bottom end, where, as we have already seen, the greatest strain comes at the moment of starting. Now where the suspended weight of rope is counterbalanced by a tail rope—which, as I pointed out at the Leeds meeting of the Institution of Mechanical Engineers, in August last, can probably be economically applied in cases where the depth does not exceed 500 yards or thereabouts—the weight on the rope is constant at any stage of the winding, and consequently a parallel rope is the right thing.

But perhaps the most important point of all is to diminish, as far as possible, the dead weight snatched at by the rapid starting of the engine, and this can only be done by using the lightest possible trams and cages. In the instance above given, if the cage had been of steel, instead of iron, its weight might probably have been reduced 30 per cent. or more—and I could point out instances where a much greater reduction has actually been effected—thereby reducing the total weight to be snatched at, *i.e.*, coal, tubs, cage, and chains, by about 12 per cent. But while cages are only too often considered as a convenient stock job, on which the colliery smith may advantageously employ the odds and ends of his time, and expend such bars of iron as he happens to have no other use for, while they are too often commenced, continued, and finished without any harmonious design or plan, but by the addition of one part after another, each fulfilling its own object, and adding to the total weight, but not contributing to the aggregate strength of the structure, while some of the parts most severely strained are too often weakened by injudiciously placed bolt or rivet holes, and when they fail are replaced by stouter bars and bigger rivets, the result can scarcely be satisfactory in any respect, and least of all where lightness is desired. Perhaps the next attempt is made in steel, with a result more disappointing than ever, and that ill-used material, as I have too often found when advocating its use, is for ever discredited in the eyes of the disgusted proprietor.

As there is no difficulty in making a properly designed steel cage which for any given weight of coal to be lifted shall be from 25 to 50 per cent. lighter, and shall cost no more than an iron one, it is surely time that the state of things which I have endeavoured to describe, and which, as every mining inspector knows, is only too common, should cease to exist. W. SILVER HALL.

39, Hartington-street, Derby,
June 16th.

CHANNEL BALLOONING.

SIR,—With reference to recent attempts to cross the English Channel by balloons by Colonel Burnaby, M. L'Hoste, Mr. Powell, and others, it may be remarked how much more difficult it appears for these aërial cars to be wafted over water than over land, even of a less distance across.

It would seem that balloons generally sink down when passing over the Channel waters, notwithstanding they started high up on leaving the coasts. This may be due to the air over the water being rarer and lighter than over the land at the time of ascension, in consequence of the vapour rising into it from the sea expanding it, as it would be generally fine weather then that would be selected, and the sun shining. In the air on the land there would be then less vapour, as the winds taken advantage of for vection, would be land winds only, and therefore be denser, from the greater difference of specific gravity, and give greater support to the balloon. The winds over the Channel would therefore be ascensional from the sea, and draw in air currents to them from the land, and the land wind probably on one coast would be different or opposite to that on the other coast.

It is highly likely, further, that the machine itself would become loaded with a film of moisture over all its silk, and nets, and cordage, and car, and therefore, from this additional weight, become still less capable of being borne up by the moist sea air. It is sufficiently remarkable to voyagers aboardship how soon every surface on deck and in the cabins and saloons becomes covered by damp, and gets clammy and moist to the feeling of the hand, after leaving the port of departure. It should therefore be requisite for the aëronaut always to take with him barometer and thermometer, wet and dry, to ascertain all the varying states of the atmosphere he is to pass through, and to navigate his vessel accordingly. Should the barometer fall over the sea, then it may be presumed the specific gravity of the air was diminishing, especially if the readings of the dry and wet bulb thermometers closely approached each other. The records of the observations of the thermometers at sea frequently show differences of only 2 deg. or 3 deg. between the dry and wet bulbs, of the dew point approaching to 1 deg. or 2 deg. of the temperature of the air, and of the figures of humidity reaching to 90 deg. It is presumably to be inferred that the best course, then, would be to ascend still higher up, so as to reach a drier atmosphere, far removed from the local influence of the vapours of the sea below, which might be blown away by the greater currents of the atmosphere found aloft unaffected by the surface of the earth. ICARUS.

Edinburgh.

CANADIAN PATENT LAW.

SIR,—There can be no doubt that as a field for the inventor Canada has not received that attention from patentees which that thriving and wide-spreading colony deserves. I do not, however, propose in the present instance to expound the advantages which Canada offers to patentees, I may refer to that perhaps at a future time. For the present I simply desire to point out that an amendment to the Patent Laws of Canada was passed in the last session of Parliament—prorogued on the 25th of May—which is a step in the right direction, and which promises to carry in its train a good many advantageous re-arrangements of detail in the practice of the Patent-office. Hitherto, a patent in Canada, while practically given for a term of fifteen years, was nominally granted for five years, the patentee having the option of renewing or extending the same before, that period expired for another five or ten years on payment of an additional Government fee at the rate of 20·00 dols. for each five years, being 60·00 dols. for the fifteen years. A few years ago the United States Patent-office adopted the practice of requiring patentees to state whether their inventions were patented in any other country, and where; and when such was the case the duration of the United States patent, if granted subsequent to the grant of a foreign patent, was limited to the unexpired term of the shortest foreign patent. The United States Law Courts then decided that if a Canada patent nominally granted for five years had preceded the issue of the United States patent, that the latter was only good for the unexpired part of the term of the five years, and considered the subsequent extension of the Canadian patent to ten or fifteen years as a separate and distinct grant—as, indeed, it nominally was. This proved to be a great hardship in some cases, and the new Amendment Act proposes to overcome this difficulty by defining the duration of a Canadian patent to be fifteen years' subject to the payment of twice 20·00 dols., or 40·00 dols. in cases where a Government fee for five years only is paid before the grant of the patent.

The Patent-office at Ottawa is also preparing a new form of patent document less awkward and clumsy than the former one, and changes in the office, practice, and forms, which are at present somewhat cumbersome, are also in contemplation, and may be published presently, when I will refer to them more in detail.

Ottawa, June 7th. CANADA.

SHEAR LEGS.

SIR,—In reply to "Reader's" last letter I should have stated in my first reply that the total pressure of 30 tons, which I assumed passing through the legs, was intended to include the resultant of the pull in the back stays or guy ropes, about the direction of which "Reader" gives no information, as well as that of the downhaul. "E. M. R." assumes the guy rope to be horizontal, a very unusual direction. "Reader" will also bear in mind that the 2½ tons he estimates as the tension in one part of the hoisting rope will be considerably greater in the downhaul, owing to friction. If the shear legs are for merely temporary use, a factor of safety of 6 may be adopted in place of 10, and this will, of course, materially reduce the size of the timber. If "Reader" cannot get logs of the requisite size, he should use iron or steel, or build up the legs like a large wooden mast, though the latter practice is not a very desirable one. He will, however, probably get timber of the requisite scantling in Glasgow or Liverpool. As to "Foreman's" practice, I would recommend "Reader" to be cautious about following it. A perusal of Professor Thurston's note on the same page of THE ENGINEER may, perhaps, suggest sufficient reasons. I knew another foreman who also used ordinary scaffold poles about 9in. diameter, but the result was that two men were killed by the fracture of one of the poles. N. D. Y.

June 20th.

SIR,—If "Foreman" will turn to your issue of May 25th and look at "Reader's" query, before accusing "N. D. Y." and myself of being unpractical, he will see that he has altogether missed the mark in his reply. The question is not, which is the best way of lifting a certain weight—for that "Reader" is answerable—but, given the length and inclination of a pair of legs, and weight, to get at the scantling. The dimensions I gave were quite practicable, as I am well aware of the sizes of baulk timber. Heavy weights are, it is well known, lifted every day with material really inadequate, leaving a very bare margin of safety, because engineers are often reduced to makeshifts, not having the proper material at hand. I presume, however, from "Reader's" question, that he requires the legs to be a fixture, and to last for years. I must say I do not think that "N. D. Y." has gone into the matter very fully, as he "assumes" the down haul at 30 tons = 15 tons on each leg, instead of 10½. This makes the difference between his result and mine.

In conclusion, I think I may say that "Reader" will find my figures perfectly reliable. E. M. R.

Near Walsham, June 18th.

THE VENTILATION OF THE METROPOLITAN DISTRICT RAILWAY.

SIR,—After reading the leading article in your valuable journal of 15th inst. anent "Metropolitan Railway Ventilation," it occurs to me that a thorough condensation of the steam of the locomotives might be attained by the adoption of Ramsbottom troughs between the rails to change the water in the engine tanks. A little ingenuity would soon find a way for adapting the scoop arrangement to the existing tank engines. S. H.

Leith.

CONTRACTS OPEN.

BOILERS are required for the Bombay and Baroda Railway. The number of boilers required is five, with fire-boxes complete, in accordance with specification and drawing, page 470. Barrel dome, fire-box, casing, and smoke-box tube plate, and all angle iron rivets and stays to be made of best Lowmoor iron. The barrel to be made telescopic and formed of three plates, transverse joints to be single rivetted, longitudinal seams are to be butt jointed and have inside and outside strips, and to be double rivetted, placed above the water line, the middle plate to be strengthened by a plate rivetted on the inside under the dome. The tube plate to be attached to the barrel by a ring of angle iron, bored, faced, and turned edges rivetted to both. The dome to be welded and top rivetted on, as shown, flanged at the bottom to fit barrel; the joint flanges must be well faced to make a perfectly steam-tight joint. The fire-box foundation ring to be of form shown, and the casing plates to be double rivetted at the corners. The fire-hole ring to be oval, and both fire-box and casing plates to be kept clear of the inner edge of ring. Barrel stays must be arranged, as shown on drawings. All edges of plates must be planed. Great care must be taken that the plates are brought well together before the rivets are put in. All rivets must completely fill the holes, and the heads must be true and central. The holes must be slightly countersunk, drilled, and rimered out perfectly fair with each other in all plates and angle irons. Drifting will not be allowed, and any caulking that may be required must be done with a broad-faced tool, so that the plates may sustain no injury. Wash-out plugs and mud doors to be put as shown on drawing. Boiler to be tested with water to a pressure of 200 lb., and steam to 160 lb. per square inch. When the boiler and fire-boxes have been inspected and passed, they must be carefully protected with wood packing, and where necessary, in cases as directed by and to the satisfaction of the inspector, and the following marks painted on each piece and branded or scored on each case:—

T.W.W.		Net weight
B.B. & C.I. Ry.	Con. No. 1212	Gross ,,
Bombay.		Dimensions.

All tenders must be made by filling up a form attached to the specification, which must not be detached therefrom. They are to be sent in at or before twelve o'clock at noon on Thursday, the 28th day of June, in sealed envelopes, addressed to the directors, &c. &c., and endorsed "Tender for Locomotive Boilers and Fire-boxes." It is to be understood that the seals of all tenders will be broken open and their contents examined only in the presence of the directors of the railway, but the directors do not bind themselves to accept the lowest or any tender. N.B.—Manufacturers are requested to quote price for delivery f.o.b. at the following ports: —Glasgow, Newcastle, Liverpool, London, and an early delivery is essential.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

A MORE satisfactory state of affairs is appearing in the iron market in this district. The demand is improving, and some firms are now booked well forward. The increased sale is mainly on home account, though a fair demand is likewise forthcoming for export to the colonies and other foreign markets.

Makers have no difficulty on 'Change to-day—Thursday—in Birmingham, nor yesterday in Wolverhampton, in keeping up the better prices which were last week demanded. The sheet makers were again the strongest, for certain of them are now booked fully ahead for four months, and nearly all of them are pressed for deliveries. The galvanisers are the best customers at date. Sheets used by such consumers were firm this afternoon at the advance of from 5s. to 7s. 6d. per ton mentioned last week. Doubles were variously quoted £8 5s. to £8 7s. 6d. and £8 10s., according to the condition of makers' order books; and trebles were £9 5s. to £9 10s.

The galvanisers were asking proportionately better prices for their corrugated sheets, and for prompt deliveries they are getting an advance. New orders of good extent are reaching these makers on account of South America, Australia, India, and a few other foreign markets.

Bar and hoop firms report a little more activity, but most of them are content at present with a hand-to-mouth business until prices improve. Then, and until then, they will be prepared to book forward. The hoop makers have not yet received that amount of new business from the U.S. which they had been anticipating would be forthcoming as July 1st approached.

Best bars remain at £7 10s. to £7, while other qualities range from £6 15s. to £6 10s., £6 5s., and even £6, according to the reputation of the maker. Hoops are quoted £6 10s. to £6 12s. 6d., but strips, cut to lengths, suitable for the American market, may be had at £6 5s.

Wire rods made on the Shropshire side of the district keep quiet at £7 per ton easy for the standard numbers, delivered Liverpool.

The pig market is brisk, but the briskness is almost confined to brands made outside the Staffordshire district. Vendors of some such brands have recently made big sales, and one Derbyshire representative boasted this afternoon of having sold 20,000 tons during the past fortnight or three weeks. Quotations have consequently been put up all round. Derbyshires were quoted to-day at 47s. 6d. to 48s., and even 48s. 9d.; Northampton, 47s. to 48s.; and Lincolnshires, 48s.

Hematites of Cumberland make were 60s. to 62s. 6d., while the Tredegar—Welsh—brand was firm at 65s. Native all-mines were abundant at 62s. 6d., while cinder pigs ranged from 40s. to 37s. 6d.

The mail delivered this week from Melbourne—Victoria—brings the news that at date of despatch good sales of galvanised iron had taken place at £22. Some 200 cases of Lysaght's brand had been quitted at this figure, and 100 cases of Gospel Oak brand had also been placed at a full price. Bar and rod iron were in brisk request at from £8 10s. to £9 10s. Black sheets were moving quietly at: for Nos. 8 to 18, £10 10s.; and for Nos. 20 to 26, £13. Plates are quoted £10 10s., and hoops were worth £10. Fencing wire was in good demand at from £12 to £13 10s. for the best descriptions, and from £12 to £12 10s. for other sorts.

Coal keeps quiet, and the large supply prevents prices from rising. Good forge coal is 7s. 6d. per ton, inferior sorts 6s. 6d., and a rough mixture for forge purposes from the Cannock Chase district may be had at 4s. 9d. per ton.

Arrangements are this week in progress with one or two leading ironmasters hereabouts to test the quality of some cokes made in other districts by one of the new economical processes for obtaining the tar and ammoniacal liquor which, under the old methods, is lost. If the new article should prove equal to the old, regular supplies are likely to come into the district at under the prices now current.

Colonial buyers of machinery, pumps, and hydraulic work are making some good inquiries at date. The heavy ironfounders keep busy, and the light ironfounders are also generally active. Satisfactory inquiries are to hand from India and China for various descriptions of hardwares, but the Cape trade is quiet, and prices weak. Business with South America in hardwares is tolerably good, especially the Argentine markets, while from Mexico and the United States orders come in rather slowly. From several European markets orders are being booked.

The recent heavy expenditure of the Mines Drainage Commissioners in pumping plant, which necessary, has left them with a large debt upon their shoulders. In a few weeks a mines drainage rate will be levied on the Tipton district of 9d. per ton on coal, ironstone, and slack, and 3d. on fire-clay and limestone. These are the maximum rates, and Parliamentary powers to levy them were obtained last July. An unusually large number of colliery owners have appealed for graduation, but it is probable that only a small number will be satisfied, for at the last Court held for appeals on Friday, in Wolverhampton, the legal arbitrator, Mr. G. M. Dowdeswell, Q.C., said that the Commission was now working at a loss of £8000 a year, and looked to the mineowners of the district to aid them by bearing the full rate. Any graduations allowed will be mentioned in a schedule affixed to the award which will be issued a few weeks hence.

At a meeting of ironworkers in the Brierley Hill district on Monday to consider the question of the operatives' increased contributions to the Wages Board, the men's secretary stated that several works in the Leeds district had promised to join the Board, and that if at the end of the first year it was found that the enlarged income was more than sufficient, the rate of contribution would be reduced. Ultimately it was resolved to adhere to the new scale of 6d. per head per quarter to the end of the year.

The colliers' strike in North Staffordshire has now lasted nearly six weeks, and an application on the part of the men that the masters would receive a deputation to discuss the position of affairs has been refused, the masters stating that "they are unable to see that a conference would be of any use."

The colliers, however, remain firm in their resolve to resist any reduction. The number on strike is slightly and gradually diminishing, owing to emigration to the Welsh and Lancashire coal-fields, and to men finding employment in other trades; and it is claimed that as a rule the men who find work add to the ability of the remainder to stand out by contributing to their support.

The difficulties in the way of guaranteeing early deliveries consequent upon the irregularity in the supplies of coal continue to operate to the disadvantage of the ironmasters in North Staffordshire. Yet at those ironworks which are prepared to execute orders quickly there is activity. The demand for merchant sections is the best, and in this department orders are arriving rather more freely on home and export account. The Canadian demand is expected to improve before long. Prices are firm on the basis of £6 7s. 6d. for ordinary bars, delivered Liverpool or equal; £7 for crown bars and £7 10s. for best ditto. Ordinary angles are £6 17s. 6d.; "Crown" angles, £7 10s.; and best, £8. Tees range from £7 7s. 6d. to £8. Hoops of the "Ravensdale" brand are £7 15s., and sheets of the same makers £8 5s. "Crown" plates are quoted variously at £7 17s. 6d., £8 5s., £8 10s., and according to quality, all delivered Liverpool.

The Town Council of Lichfield are desirous of enlarging their sewage farm at Curborough at an expense of £8000, and Mr. A. Taylor has just held an inquiry on behalf of the Local Government Board touching the scheme. It was stated that the present farm was something like 38¾ acres in extent, and the proposed additions 44¾ acres. The expenditure on the sewerage works up to the present time amounted to £27,718. Loans had been contracted to the amount of £29,136, thus leaving an unexpended balance of £1418. The inspector visited the farm and will report in due course.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—To some extent it may be said that the iron market here has shown an improvement during the past week. There are buyers in the market when prices are sufficiently low, and business to a moderate extent has been possible where makers have been willing to go a little below their quoted rates. Orders, however, are still difficult to get at makers' full prices; but the temporary necessities of producers having apparently been pretty well met by the sales effected during the past week or so at a little under these prices, there is now less disposition to entertain low offers, and to this extent the market is steadier. The business thus done has been in pig iron, but an improvement is also noticeable in some descriptions of finished iron; there has been more doing in sheets for shipment, and although it has not yet transpired that any actually large orders are being given out for the United States, there is an impression that American buyers are beginning to feel their way in the market preparatory to business, and makers are stiffening in their prices.

There was a good attendance at the Manchester iron market on Tuesday, with a moderate amount of business stirring. Pig iron makers, however, following the orders which had been booked during the previous few days at a little under list rates, showed a disposition to hold for full prices, and this checked buyers. Lancashire makers of pig iron have been able to secure tolerably good orders for delivery over the remainder of the year at a trifle less money than they have lately been asking, and on Tuesday they could have sold on the basis of prices they would have taken a week or so back, but they are now firm at 45s. to 45s. 6d., less 2½ for forge and foundry qualities delivered equal to Manchester. In district brands fairly good sales have also been made at low figures. In some cases sellers have taken about 44s., less 2½ for Lincolnshire forge iron delivered here, but the average price asked is 44s. 4d., with foundry quoted at 45s. 10d., less 2½ delivered.

The reports received from the leading finished iron makers are to the effect that works are kept fairly well employed, and that trade is steady at late rates; there is, however, a lack of any animation in trade generally which does not encourage any feeling of confidence with regard to the future. In sheets, as already intimated, makers are busier, and for delivery equal to Manchester or Liverpool, the minimum prices are now £7 17s. 6d. to £8 per ton. For bars and hoops, however, the demand is still only limited. For good ordinary bars the leading makers are still firm at £6 5s. per ton delivered equal to Manchester, but in many cases less money than this is being taken to secure orders; for hoops the average price is about £6 10s. to £6 12s. 6d. per ton delivered.

Further inquiries I have made respecting the condition of the engineering trade bear out the conclusions drawn last week from the reports of the trade union societies. Although there is no actual running out of work, and the demand for labour continues fairly brisk, there is a quietening down in the general branches of industry, apart from locomotive building and machine tool making —which are kept busy by special causes; and it may be said that business is in an uncertain condition, which is tending to produce some feeling of uneasiness with regard to the future.

The members of the Manchester Association of Employers, Foremen, and Draughtsmen on Saturday paid a visit to the extensive works of Sir John Brown and Co. at Sheffield, and were shown the various operations carried on by the firm. The chief feature of interest was the opportunity of inspecting the different processes connected with the manufacture of the patent compound armour-plates. The special construction of these plates I need not further describe, beyond stating that they are composed of about one-third steel and two-thirds iron. A surface plate of hardened rolled steel is welded to a backing of iron by an arrangement which allows molten steel to be cast in between the steel surface plate and the iron backing. The complete plate is then heated in the furnace and rolled to the requisite size and thickness. The firm have orders in hand for the English, Italian, and Brazilian Governments, and during the visit of the party a plate weighing 18 tons, which was about to form a portion of a barbette on H.M.S. Warspite, building at Chatham, was rolled down from 15in. to 8in. in thickness, and afterwards bent to the requisite radius under a hydraulic bending press, capable of exerting a pressure of 4000 tons. Afterwards the visitors were taken to the shops where the planing and finishing of a number of plates was in progress, and for which special and exceptionally powerful plant has been put down. Three massive planing machines, by Shanks and Co., of Johnstone, near Glasgow, attracted special attention, and they are probably the largest machine tools of the kind that have been put down for any works in the world. One of the machines weighs 170 tons, and is capable of taking in work 14ft. by 12ft. It may be interesting to add that in order to insure the requisite strength of construction, Mr. Ellis, the manager of Messrs. Brown's works, had the drawings for the machines prepared, and then ordered them by weight, paying £20 per ton. Another special machine which attracted considerable notice was a circular planing machine for dealing with the plates after they have been bent. In this machine the plate forms the guide for the tool, so that whatever the shape of the plate is itself, the path for the slide which carries the tool box and a specially arranged balance weight comes into action to keep the tool always to its work, whether travelling upwards over one half, or downwards over the other half of the plate. I may mention in connection with the manufacture of armour plates that the largest compound steel and iron plate yet made by the firm weighed nearly 40 tons in the rough and 31½ tons finished, and the greatest thickness of compound plate has been 19in.; iron plates have, however, been made up to 24in. in thickness. Amongst other interesting processes in the works was the flanging of marine boiler end plates, which is done by a powerful hydraulic press. By this machine boiler ends 18ft. diameter, 1in. thick, with 10in. flanges, can be flanged in two plates, and the furnace holes flanged at the same time. The plate to be flanged, after being sheared to the size required, is heated to a red heat all over. It is then drawn from the furnace into the press and is held against the upper dies by a die plate carried by a series of rams. The main rams then lift the table with the blocks, which turn up the overhanging edges of the plate, thereby forming the flange. Other processes which the visitors had an opportunity of inspecting included the making of large forgings in the steam hammer shops, the manufacture of steel by the Siemens - Martin process, the rolling of steel boiler plates, and the production of steel tires and railway springs. The inspection of the works occupied the whole of the morning; and afterwards the party proceeded by conveyances to Chatsworth, dining at the Devonshire Arms Hotel. On the motion of Mr. Thomas Ashbury, C.E., the president of the association, seconded by Mr. John Craven, a hearty vote of thanks was passed to Sir John Brown and Co. for so kindly throwing open their works for inspection. The vote of thanks was responded to by several representatives of the firm, and Mr. Richards observed that they were looking forward to making steel castings superior to iron forgings, and he hoped they would be equal to the best forged steel. With hot steel they could do as they liked; but he might mention that pieces that had been cut out of their castings they had been able to bend cold to an angle of 180 deg.

From armour plates to guns is almost a natural transition, and I may mention that Sir Joseph Whitworth and Co., of Manchester, are at present very busy on both light and heavy guns for abroad, and upon gun material for the British Government; the firm have also in hand an order for about 1000 brass ammunition magazines, specially constructed for holding the gun charges; these they are making for foreign Governments.

The coal trade is quiet all through, and many of the pits are not working more than three to four days a week. For prompt sales in bulk sellers are willing to book orders at under their list rates, but forward contracts colliery proprietors will not look at except at an advance upon present rates. At the pit mouth the average prices are as under:—Best coal, 9s.; seconds, 7s. to 7s. 6d.; common, 5s. 6d. to 6s. 3d.; burgy, 4s. 6d. to 5s.; good slack, 3s. 9d. to 4s. 3d.; and common, 2s. 6d. to 3s. 3d. per ton.

Shipping is rather more active, but low prices still rule.

Barrow.—I have noticed no change during the past week in the hematite iron trade. Few orders have come to hand, and the demand still continues quiet. It is a noticeable fact that whilst a fair inquiry for forward delivery exists, there is not that disposition to enter into business transactions of any magnitude which would be the case if complete confidence was felt in the future. I see, however, no signs of any improvement during the summer or even winter season. In consequence of this, makers are evincing a disposition in the direction of reducing the output. I do not see why this should be done, as the metal shipments have largely increased. The unpleasant fact remains that stocks are very large for the time of the year. There is rather an easier tone in the prices. Large quantities of all qualities of railway and merchant material are being yielded at the steel works. There is an improved business being done in the iron shipbuilding trade, as several new orders have been booked. I expect that as the season advances we shall see an increased activity displayed in this trade, especially when the new orders are proceeded with. The activity is principally in marine engineering, and in a short time some heavy work will be put in hand. There is a fair but not over busy employment in the boiler and ironfoundry trade. There is a fair consumption of iron ore, but the requirements of the smelters are somewhat small. Prices are low but steady, 9s. per ton and upwards being the quotation. There is a good business doing in coal and coke, especially in manufacturers' qualities. On domestic account the demand, as is usual at this period of the year, is rather small. There is an increased consumption on shipping account. Prices remain steady.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THERE is still considerable activity in the house coal trade in spite of the favourable weather. At Aldwarke Main—Messrs. John Brown and Co., Limited—the miners are employed four to five days a week, nine hours a day. Messrs. Newton, Chambers, and Co., Limited, Thorncliffe, during May last, sent the largest tonnage of coal to the metropolitan market, their weight being 18,955 tons. Claycross—Derbyshire—being next with 18,881 tons, Langley Mill next with 18,649 tons; then Eckington, 13,122 tons; Birley—Sheffield—Coal Company, 12,781 tons; Blackwall, 12,440 tons; Pilsley, 11,900 tons; Grassmoor, 10,565 tons.

An interesting feature of the iron trade is the fact that the Thorncliffe Company Collieries—Messrs. Newton, Chambers, and Co., Limited—are now sending iron to the United States as the result of samples tried there some time ago. In the iron trade generally there has been no improvement during the week.

Armour-plates and large marine castings are in brisk demand, and there is an increasing call from distant markets for small steel castings. Steel rails are still dull at very low quotations. Messrs. Charles Cammell and Co., Limited, Cyclops Steel and Ironworks, expect to be able to commence their establishment at Workington about the end of next month. Nothing has transpired since the company came to the conclusion to transfer their export rail trade, to cause any doubt as to the soundness of that decision; in fact, other rail manufacturers are now face to face with the awkward dilemma. Mr. George Wilson long ago pointed out—they must either give up the trade or go and do it near to the raw material and the port of delivery.

The protracted dispute in the file trade is at an end. After three months' struggle the workmen have given in, and conceded to the 10 per cent. reduction sought for by the employers. Mr. S. Waters, the Union secretary, in intimating this decision to the Manufacturers' Association, says that the men still believe the demand unwarranted by the actual condition of trade, and that they yield simply to force. They also express their regret that the employers did not concede their request for arbitration, by which means they believe the question would have been settled long ago. There is still a dispute pending in the razor trade; but it is not expected that this will result in a strike or lock-out. The pressure from America for orders to be completed this month is now decreasing, and with the commencement of July, when the new tariff comes into operation, will entirely fall away. The razor forgers desire an advance of 10 per cent. The chief feature about this department at present is the progress the hollow-ground razor has made. It is now coming into general use. At one time the secret of hollow-grinding lay with the Germans, and Sheffield firms had to send their razors to Germany to be "hollow" ground. Now the process is generally adopted in Sheffield, and German assistance has been dispensed with.

The Cork Exhibition promises to be a greater success than Dublin. The latter was killed by the foolish decision of the committee to exclude English-made productions. At Cork a more liberal and enlightened policy has been followed. I am afraid, however, that the Dublin Exhibition has somewhat ruffled the English manufacturers. As yet I can hear of only one Sheffield firm—Messrs. W. R. Humphries and Co., of Eyre-street Works—who are sending goods to Cork. Their exhibit, however, is comprehensive, and contains many productions of high merit in carvers, in ivory handles, with solid silver ferules and caps, farriers', palette, and bowie knives, ladies' and gentlemen's knives, table cutlery of all kinds, sportsmen's and fishermen's knives, scissors, ladies' chatelaine and toilet knives, razors, &c. A novelty in the exhibit is the adaptation of xylonite, the new substitute for ivory to the handling of table cutlery and spring knives. It seems to suit the purpose very well, though it lacks the mellow, cream-like transparency of best African ivory.

Two thousand Sheffield workmen are expected to travel to the London Cutlery Exhibition on Saturday, to see the specimens of workmanship and "historic swords" exhibited there. The Sheffield artisans have carried off the honours wherever they have competed. It was intended that the exhibition should close on the 23rd, but it will certainly not close early, so that the visitors may regard the objects with the minute interest which experts alone can show.

The splendid cabinet of cutlery presented to the Archbishop of York last week will also be on view that day, his Grace having granted the request of the London Cutlers' Company to that effect. After being shown at London, it will be returned to Sheffield, where there is a desire for its being seen by others beside the craftsmen of cutlery and kindred industries.

The members of the Manchester Association of Foremen Engineers, some sixty in number, accompanied by their president, Mr. Thomas Ashbury, visited the Atlas Works—Messrs. John Brown and Co., Limited—on Saturday last. Mr. Eaves, the chief engineer, with Mr. J. Dyson, conducted the party over the works, where they witnessed the rolling of an armour-plate, the flanging of marine boiler-plate ends, the casting of propeller blades, tin and plate rolling, &c. They afterwards drove over the Moors of Chatsworth.

The report of the Ebbw Vale Steel, Iron, and Coal Company, Limited, the shares in which are largely held in the Manchester and Sheffield districts, was issued this week. The gross profit of the year is £84,476, and after payment of expenses, interest on debentures, &c., there remains a net profit for the year of £42,916, of which £22,028 is written off for depreciation, and a balance of £20,887 remains, which, with the last year's balance, makes £42,058. Out of this the directors recommend the payment of a dividend of 5s. per share, carrying forward the balance of £23,439 to next year. No less a sum than £32,438, or nearly twice as much as has been paid in dividends, has been spent in new works this year. The report is regarded favourably.

In the *Gazette* is recorded the name of Mr. Sam. Jackson, son of the late Mr. Samuel Jackson, of Carlton House, Attercliffe, as having received the order of the Indian Empire, the outward and visible signs of which are a star and ribbon, and the letters "C. I. E." Mr. Jackson is chief locomotive and carriage superintendent of the C. I. P. Railway. Their principal workshops are at Parel, near Bombay. During the Egyptian War it was by the staff that the bulk of the steamers employed from Bombay by the Government were fitted up as transports, the Parel Works undertaking everything from engines to upholstery and electro fittings.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

QUIETUDE has prevailed in the Cleveland pig iron trade during the last few days. At the market held at Middlesbrough on Tuesday last scarcely any sales were made either by makers or merchants. The smelters connected with the combination have decided not to sell No. 3 G.M.B. at less than 40s. per ton, for early f.o.b. delivery. Many of them have orders which will last several weeks, and they threaten to reduce the output still further if things do not improve by the end of this month. Merchants still offer No. 3 at 39s. 3d. per ton, and only very small quantities can be had at less than that figure.

There is nothing being done in warrants, though they are offered at 39s. per ton.

The stock of Cleveland pig iron in Messrs. Connal's store at Middlesbrough decreased 1530 tons during the week ending Monday last, the quantity held on that day being 75,637 tons. The stock in their Glasgow store is now increasing. On Monday it amounted to 583,385 tons.

The exports from the Tees continue exceptionally heavy, and should they continue at the same rate, there will be a large reduction in stocks to report at the end of the month, the inland deliveries being also good. The quantity of pig iron shipped up to Monday night was 59,057 tons, as against 47,648 tons to May 18th, and 36,140 tons to June 18th, 1882.

The demand for manufactured iron has not improved during the past week. Large consumers do not show any more disposition to buy even at the lower rates which are now ruling. The majority of the mills are, however, fully employed, and prices have not fallen since last week. Ship plates are £6 to £6 5s. per ton; angles, £5 12s. 6d. to £5 15s.; and common bars, £5 17s. 6d. to £6, all free on trucks at makers' works, less 2½ per cent. discount. Puddled bars are £3 12s. 6d. per ton net. The steel rail trade is very dull, and the most that can be got for heavy sections is £4 15s. per ton.

The Old Evenwood Colliery, which has been idle for some years, has been started again this week.

The electric light is shortly to be tried on a small scale at the Hetton Collieries, and if the managers are satisfied with the trial, it will probably be adopted extensively. There are eight drawing shafts at these collieries, and the output of coal is about one million tons per annum.

The Consett Iron Company made an experimental trial of their Siemens-Martin steel-making plant on the 13th inst., when some steel ingots of first-class quality were produced. The company hope to have the works in full operation in about a fortnight, when they will be in a position to supply steel plates for ships, &c., in quantity. The new works are on the south-west side of the old ironworks, and are constructed on the most approved plan. The machinery, which is of the newest design, was supplied by Messrs. Davy Bros., Limited, of Sheffield.

At a meeting of shipowners, representatives of Chambers of Commerce, and shipowners' societies from the Hartlepools, Middlesbrough, Stockton and Whitby, held at Stockton on the 13th inst., Mr. John Hall, underwriter, of London, and Mr. William Gray, of Hartlepool, were chosen to represent the above ports upon the Committee of Lloyd's Registry of Shipping. The committee have again been urged to allow a third representative for this important district, but reply that they cannot alter the decision they recently arrived at.

The Eston Steel Works, belonging to Messrs. Bolckow, Vaughan, and Co., Limited, are again fully at work. The decision of Mr. Coleman, who has been chosen to act as arbitrator, will, it is expected, settle the dispute, so far as the men employed in the manufacturing department are concerned. There is likely, however, to be further trouble with the mechanics, as the men are told they will have to submit to a reduction of 5 per cent., and they say they are determined to have the old rate of wages or they will again come out on strike.

It is reported that the Walker Rolling Mills Company, Limited, of Walker-on-Tyne, have ceased active operations for the present. It will be remembered that this company was formed about a year and a-half ago, when the price of manufactured iron was tending upwards. These works are the same as those formerly belonging to Messrs. Bell, Ridley, and Bell, and at an earlier date to Messrs. Losh, Wilson, and Bell. How long the stoppage will last is not known, nor is any cause assigned, except the present unremunerative state of the plate trade.

The large corn-laden American barque which struck on the "Salt Sear" off Redcar on the 27th ult. has broken up, and the wreckage has drifted ashore. A certain quantity of corn was removed, but £10,000 worth has been lost. Attention has been called to the excellent quality of the iron of which the numerous bolts used in the ship was made. Is was presumably American. Not a bolt is to be found broken short off, whilst hundreds are to be seen bent and twisted in all directions without any sign of fracture.

A meeting of the guarantors for the reception of the Iron and Steel Institute was held at Middlesbrough on Tuesday last, and various committees were formed for the purpose of carrying out the details of the visit. It is anticipated that the meeting will be a most interesting and successful one.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE best steam coal commands fully a shilling a ton more now than it did two months ago. The ruling price is 11s. f.o.b. I have heard of sales effected for deliveries in the autumn at 10s. 6d., a certain proof that no downward market is contemplated. In fact, as soon as the large contracts now in hand run out I shall expect prices to go up still more.

The steam coal trade, as well as the house coal, is very firm, and the activity in meeting demand is shown at every colliery, at each of the docks, and at the railways. The only dark spot in the picture is at Mountain Ash, where a senseless "doctor's dispute" has caused a strike. The men at Nixon's by last report have offered overtures, so I shall expect that after a few days' more idleness work will be resumed. About 2000 men are out. The Plymouth Collieries' dispute has been settled amicably.

Coal exports, foreign, scarcely touched 200,000 tons this week from all parts. This was due to shipping not coming in. Books are full, however, and there is no cause of complaint. This week Mr. W. T. Lewis issued a circular inviting co-operation of shippers in getting an ample supply of trimmers at the tips to expedite work.

The sister industry iron is better. A movement is on foot to establish steelworks in connection with Plymouth and Aberdare. The impression is general that something will be done, but some time must elapse. An able and influential gentleman is at work in the matter.

The report of the Ebbw Vale Steel, Iron, and Coal Company gives us an insight into existing trade. The gross profits for year ended March 31st are £84,478 7s. 10d. The net profit after paying off expenses of office, legal expenses, interest on debentures and fully paid up shares, amounts to £42,916. The outlay has been larger than usual on account of the construction of necessary works and improvements. For this year the company start well, and have leased an important colliery, the Abercarne, to a substantial company.

At present I hear that Ebbw Vale is tolerably busy in rails, some for Texas. Prices in the district, varying with specifications, are still about £4 15s. Tin-plate advances are kept up, and tone is better.

New docks are contemplated at Milford Haven. The site is in Pembroke river, and the extent twenty acres.

A movement has been started in good quarters at Swansea to get increased tipping accommodation on the Great Western side of the north dock. A little active co-operation by railway and harbour trustees is needed to ensure a successful issue.

Business is brisk at Newport, both in iron and coal shipments. The principal iron and steel shipments of the week from that port were: India, 2360 tons; America, 1100 tons; Canada, 500 tons.

Increased ranges of coke ovens, in connection with some of the principal ironworks, and a few other indications of value to the practical eye, give a hopeful outlook for the iron trade. At Swansea the metal trade is promising. About 11,000 tons of minerals of all descriptions came into this port last week, and most of the small industries are busy. Patent fuel continues brisk here and at Cardiff.

The appointment of inspector of coals at Cardiff for the colonies has been given to Mr. Ponsonby, of Newport, late of the mercantile marine.

The steamer Clarita is to be sold at Swansea next week.

The Cwmavon Copper Works are being offered on lease.

Bilbao iron ore is dull of late, and there are no signs of improvement.

I am glad to note an increased spirit in getting up new, or in re-starting small scientific industries in Wales—such as chemical and soap works and the utilisation of waste products, some of these in connection with gasworks and coke ovens.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been quiet this week, with fluctuations in prices confined within extra narrow limits, there being on some days a rather firmer tone in business. This is partly owing to purchasers having in a number of cases paid their money and locked up warrants, which are accordingly not quite so plentiful as usual. The past week's shipments of pigs have been fair, but they compare unfavourably with those of the corresponding week of 1882. The quantity of pig iron sent to the United States is comparatively small, and there is little or no prospect of an improvement. Italy is, however, taking a larger quantity of Scotch pigs than usual. The imports of Cleveland iron are heavy, and the Scotch manufacturers are increasing their consumption of both it and hematite, in consequence of the cheap rates at which they can be obtained. During the week the stock of pigs in Connal's Glasgow stores has increased by fully 2000 tons.

Business was done in the warrant market on Friday forenoon at 47s. 1d. to 47s. cash, also 47s. 2d. to 47s. one month; the afternoon quotations being 46s. 11d., 46s. 10½d., and 46s. 11½d. cash, and 47s. 1d. one month. On Monday forenoon business was done at 46s. 11½d. to 46s. 10d. cash, and 47s. 1d. to 46s. 11½d. one month. In the afternoon transactions took place at 46s. 11d. cash and 47s. 1d. one month. Tuesday's business was at 46s. 11d. and 47s. cash, and 47s. 1d. and 47s. 1½d. one month. Business was done on Wednesday at 47s. 0½d. to 46s. 11d. cash, and 47s. 1½d. to 47s. 1d. one month. To-day—Thursday—transactions were effected from 46s. 11d. to 47s. cash, and up to 47s. 2d. one month.

In several cases the values of makers' iron are below those of last week, the quotations being as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 57s. 6d.; No. 3, 53s. 6d.; Coltness, 60s. and 53s. 6d.; Langloan, 60s. 6d. and 53s. 6d.; Summerlee, 58s. 6d. and 50s. 6d.; Chapelhall, 57s. 6d. and 54s.; Calder, 58s. 6d. and 50s. 6d.; Carnbroe, 51s. 6d. and 49s.; Clyde, 50s. 6d. and 48s. 6d.; Monkland, 48s. 3d. and 46s. 3d.; Quarter, 47s. 6d. and 45s. 6d.; Govan, at Broomielaw, 48s. 3d. and 46s. 3d.; Shotts, at Leith, 60s. 6d. and 56s.; Carron, at Grangemouth, 48s. 6d. (specially selected, 54s.) and 47s.; Kinneil, at Bo'ness, 49s. and 47s. 6d.; Glengarnock, at Ardrossan, 54s. 6d. and 48s.; Eglinton, 48s. and 45s. 6d.; Dalmellington, 48s. 6d. and 47s. 6d.

There is no cessation of activity in the Scotch malleable iron trade, but, owing to great competition, prices are not so good as could be desired. The engineering department is still expanding, there being a number of extensions and additions to the existing places of business now in course of being provided. The activity which marks this important branch is by no means confined to the Glasgow district, but is more or less apparent in every locality. The shipments of iron manufactures from Glasgow in the past week embraced £21,200 worth of machinery, £2881 sewing machines, £3383 steel manufactures, and £22,220 iron manufactures, besides the value of the pig iron despatched.

In the Lanarkshire district the supply of coals for inland consumption appears to be rapidly increasing, the result, no doubt, of the fine weather, coupled with the steady way in which the colliers have been working. There is rather less doing at some of the ports in the shipment of cargoes for abroad, but this branch of the trade has been so good hitherto that a slight lull in the middle of summer ought not to be felt as a very great misfortune.

At Bo'ness the shipping trade has been active, upwards of 5000 tons of coals having been despatched in the course of the week.

About the same quantity was sent off at Leith, and fully 6000 tons at Grangemouth.

Great complaints are heard among the colliery owners of Fife and Clackmannan regarding the small prices of coals, which range from 6s. 6d. to 7s., according to quality, f.o.b. at the port. There is, however, a fair business doing in that district. In Ayrshire trade is moderately active, and it is reported that the employers have resolved, for the present at least, to abandon their intention of reducing the wages of the colliers.

The wages question continues to agitate the miners of Fife and Clackmannan, the men being advised by their secretary that, notwithstanding the frequent assurances given to the contrary, the condition of trade is such that the employers could afford to return the 6d. per day which was deducted from the wages some time ago. The miners of the western district of Fife, to the number of about 2000, met at Cowdenheath on Saturday, and resolved that "should the coalowners not agree to concede the advance before Saturday, 23rd June, that it be a recommendation from this meeting that the Fife and Clackmannan miners terminate their contracts, with the view of commencing a system of restriction that may be agreed upon by a representative meeting to be held on that day." There is some expectation that the matter will be settled by a concession of 3d. a day.

The dispute on the question of wages in the Glasgow engineering trade is settled, the employers having made a concession to the better classes of workmen of a farthing an hour. About 200 men struck at the works of Messrs. Robert Napier and Sons, but the matter in dispute was compromised, so that the men were only idle for one day.

THE OUDE AND ROHILKUND RAILWAY COMPANY.—At the forty-first ordinary general meeting of shareholders, held last week, the chairman said the receipts from passengers were in excess of those of any similar period since the railway had been open for traffic. The number of lower-class passengers carried was higher by 37,352 than in the corresponding half-year of 1881, but the distance travelled was shorter, the average mileage being 50·88, as against 53·40. This showed that the lower classes were beginning to travel on inducements apart from business. Every inducement to promote travelling amongst the lower class of natives, such as separate carriages for women, female ticket collectors, comfortably seated lower-class carriages, reserved compartments at half a pie per mile extra, &c., was held out, and by so studying caste prejudices and other native requirements, they hoped to promote excursions for pleasure and improvement, distinct from business altogether.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

*** When patents have been "communicated," the name and address of the communicating party are printed in italics.

12th June, 1883.

2907. MOULDING, &c., MACHINERY, J. H. Johnson.—(*G. J. F. Couffinhall, France.*)
2908. GRINDING GRAIN, T. Inglis and C. Herbert, Edinburgh.
2909. DRYING OVENS, G. F. Edwards, London.
2910. MILLING, &c., FELT HAT BODIES, &c., J. Southworth and W. Hamnett, Stockport.
2911. CONSTRUCTING, &c., SHIPS, R. H. Brandon.—(*E. Lavarenne, Paris.*)
2912. BARBED FENCING, W. H. Johnson, Clapham.
2913. BURNING SMALL PYRITES, &c., M. Finch, Silvertown, and W., J., and S. Willoughby, Plymouth.
2914. WHEELS, A. Longsdon.—(*A. Krupp, Essen.*)
2915. JACQUARDS for LOOMS, J. Garstang and A. and A. Harling, Burnley.
2916. CAR AXLE-BOXES, H. J. Haddan.—(*J. A. Hamilton, New York, U.S.*)
2917. SADDLES for BICYCLES, &c., S. Davis, Hove.
2918. BUOYS, H. J. Haddan.—(*F. Vidal, France.*)
2919. FILES, &c., H. J. Haddan.—(*F. Vidal, France.*)
2920. COMBINED SEAT, &c., J. Wigglesworth, Saltaire.
2921. ROOFING TILES, C. Major, Bridgwater.
2922. ELECTRIC METERS, J. E. H. Gordon, London.
2926. CARRIAGES for HEAVY ORDNANCE, W. Anderson, London.
2924. INSULATING, &c., COMPOUND, A. R. Leask and E. Torrini, London.
2925. OBTAINING MOTIVE POWER, A. W. L. Reddie.—(*T. M'M. Wilson, Bergen, Norway.*)
2926. LAMP BURNERS, P. C. G. Klingberg.—(*A. F. Lundeberg, Stockholm, Sweden.*)
2927. GAS MOTOR ENGINE, F. H. W. Livesey, London.
2928. MOULDING, &c., MACHINES, W. R. Lake.—(*O. R. Chase, Boston, U.S.*)
2929. WATER-CLOSETS, F. Piercy, London.
2930. CENTRIFUGAL PUMPS, &c., W. R. Lake.—(*D. E. Farcot, Paris.*)
2931. SCUTCHING FLAX, &c., W. R. Lake.—(*T. Burrows, Paris.*)
2932. COWLS, &c., J. W. Holland, London.

13th June, 1883.

2933. INDICATING, &c., the DEPTH of WATER, R. I. Barnes and H. S. Heath, London.
2934. SEWING MACHINES, J. McHardy, Dollar.
2935. LOOMS, R. S. and R. Collinge, Oldham.
2936. BRAKES, R. Atkin, Wandsworth.
2937. STEAM TRICYCLE, J. Imray.—(*La Société Hemart et Compagnie, Paris.*)
2938. TELEPHONIC APPARATUS, J. M. Betts, Edmonton.
2939. COLOUR BOXES, C. Davis, London.
2940. GAS STOVES, H. J. Haddan.—(*R. Kutscher, Leipzig.*)
2941. BUCKETS for DREDGING, &c., C. Jarvis, Liverpool.
2942. SPINNING MACHINERY, F. Heslop, Leeds.
2943. CLAMPING APPARATUS, W. P. Thompson.—(*C. Mansion, Paris.*)
2944. DRIVING CENTRIFUGAL MACHINES, A. Watt, Liverpool.
2945. TREATING ORES, J. C. Butterfield, London.
2946. SMOKE-CONSUMING APPARATUS, C. Mace and J. Brewster, Sunderland.
2947. SPIRIT COOKING STOVES or LAMPS, D. Poznainski, London.
2948. FOLDING PACKING CASES, &c., H. Greene, London.
2949. INSULATING WIRES, J. H. Johnson.—(*La Société A. Chertemps et Cie., Paris.*)
2950. FASTENERS, G. H. Jepson, London.
2951. FURNITURE CASTORS, W. R. Lake.—(*M. Valkenhuizen, Paris.*)
2952. STEAM BOILERS, W. R. Lake.—(*A. H. Crockford, Newark, U.S.*)
2953. STEAM HYDRAULIC, &c., MOTORS, T. Morgan.—(*Messrs. Bonicard and Huet, Bordeaux.*)

14th June, 1883.

2954. LAWN TENNIS BATS, A. J. Altman, London.
2955. REGENERATIVE LAMPS and GAS-BURNERS, C. Pieper.—(*H. Studer, Paris.*)
2956. BOILERS, E. G. Rock.—(*J. Lees, Oamaru, and J. W. Rock, Sydney.*)
2957. TRICYCLES, &c., R. C. Jay, Bayswater.
2958. BLEACHING KIERS, C. L. Jackson and J. Westley, Bolton.
2959. AUTOMATIC REGISTERING APPARATUS, J. Mearns, Salford.
2960. LOOMS, W. H. Kenyon, Denby Dale.
2961. BOBBIN NET, &c., MACHINES, A. C. Henderson.—(*L. R. Dufeutrelle, Paris.*)
2962. MANUMOTIVE VELOCIPEDES, W. P. Thompson.—(*S. Ernin, Michle, Austria.*)
2963. METAL FENCING, A. Whitgrove, Worcester.
2964. ENAMELLING MOULDED ARTICLES, C. D. Abel.—(*A. Schierholz, Plaue, Germany.*)
2965. STORING, &c., ELECTRIC ENERGY, F. J. Cheesbrough.—(*C. T. Tomkins, New York, U.S.*)
2966. MARKING, &c., the SCORE of LAWN TENNIS, J. H. Wilkinson and G. S. Rogers, Durdham Down.
2967. STENCIL TRAPS, J. E. Manock, Heywood.
2968. SPANNERS, J. C. Bauer, London.
2969. WATER-CLOSET BASINS, R. McCombie and W. Seaman, London.
2970. DISINTEGRATING RAGS, C. Pieper.—(*H. Friederichs and C. Philippi, Bainholz, Germany.*)
2971. BURNERS, Sir J. N. Douglass, Dulwich.

15th June, 1883.

2972. FASTENINGS for SHIRT STUDS, &c., H. Owen, Birmingham.
2973. BARBED FENCE WIRE, A. M. Clark.—(*A. Cary and E. A. Moen, New York, U.S.*)
2974. PENCILS, J. F. Williams, Liverpool.
2975. ENDS of BRACES, G. Walker, Birmingham.
2976. BUTTONS, &c., W. B. Fitch, Deptford.
2977. RAISING, &c., the CHIMNEYS of PORTABLE ENGINES, J. P. Coultas, Grantham.
2978. CREATING A VACUUM in the BULBS of INCANDESCENT LAMPS, C. H. Stearn, Forest-hill.
2979. ELECTRIC HAND-TOOL, T. H. S. Hawker, Moseley, and J. W. Salaman, Edgbaston.
2980. RAILWAY CARRIAGES, H. E. Newton.—(*B. T. Hutchinson, Cape Town, South Africa.*)
2981. AUTOTYPOGRAPHICAL MACHINE, L. A. Groth.—(*D. F. Berdugo y Ortiz, Madrid.*)
2982. LIFTS, H. J. Haddan.—(*R. Liebig, Leipzig.*)
2983. WASHING, &c., WOOL, H. J. Haddan.—(*E. Tremsal, Loth, Belgium.*)
2984. ELECTRIC WIRE CONDUCTORS and INSULATORS, J. Greenwood, Bacup.
2985. GENERATING, &c., CHEMICAL SOLUTIONS to PRODUCE CARBONIC ACID GAS, A. F. Spawn, Oakland.
2986. TILLS, J. C. Cox, London.
2987. RETAINING and FACILITATING the DELIVERY of RIBBON, &c., on CORES or REELS, E. Jones, London.
2988. ELECTRO-MOTORS, R. D. Bowman, London.
2989. COMPOUNDS for MAKING EFFERVESCENT LIQUIDS, W. R. Lake.—(*G. Stollwerck, Cologne-on-the-Rhine.*)
2990. SODA and POTASH, J. H. Johnson.—(*Messrs. Crespel Brothers and Martin, Lille, France.*)
2991. PROTECTING IRON and STEEL SURFACES, A. S. Bower, St. Neots.
2992. PLATE ROLLING MILLS, C. Davy, Sheffield.
2993. GALVANIC ELEMENTS, F. Wirth.—(*C. Pabst, Stettin.*)
2994. ELECTRIC INCANDESCENCE LAMPS, A. M. Clark.—(*J. M. A. Gérard-Lescuyer, Paris.*)

16th June, 1883.

2995. METALLIC ALLOYS, G. Selve, Altena.
2996. BLANK CARTRIDGE, C. D. Abel.—(*W. Lorenz, Carlsruhe, Germany.*)
2997. PACKING for STEAM ENGINES, H. Montgomerie, Cleadon.
2998. SCREWING APPARATUS, J. Heap, Ashton-under-Lyne.
2999. WASHING, &c., MACHINERY, J. and P. Hawthorn and J. P. Liddell, Newtown.
3000. ELECTRIC ARC LAMPS, S. Pitt.—(*N. H. Edgerton, Philadelphia, U.S.*)
3001. DYNAMO-ELECTRIC MACHINES, S. Pitt.—(*N. H. Edgerton, Philadelphia, U.S.*)
3002. HEAT-RETAINING and LIFE-SAVING DRESSES, A. W. Ward, Kilburn.
3003. ARC, &c., LAMPS, T. H. S. Hawker, Moseley.
3004. RECOVERING AMMONIA from COMBUSTIBLE GASES, J. and J. Addie, Glasgow.
3005. STEAM BOILERS, W. Hindson, Gateshead-on-Tyne.
3006. STOCKINGS, A. P. Sheffield and A. W. Wills, Leicester.
3007. INSULATORS for ELECTRIC WIRES, L. B. Gray, U.S.
3008. GALVANIC BATTERIES, J. Oliphant and J. W. H. R. Gowan, London, and E. B. Burr, Walthamstow.
3009. STEAM BOILERS, T. Carter, Sunderland.
3010. PRODUCING ILLUSORY DRAMATIC EFFECTS, W. R. Lake.—(*J. W. Knell, Boston, U.S.*)

18th June, 1883.

3011. MARKING GROUND for LAWN TENNIS, &c., J. G. Howard, Biddenham.
3012. PROTECTING CORKS, &c., E. Holliday, London.
3013. STENCH TRAPS, W. Ayres, London.
3014. STEAM ENGINES, C. Baumgarten, Berlin.
3015. RISING HINGES, G. W. von Nawrocki.—(*H. Haltaufderheide, Cassel, Germany.*)
3016. WELDLESS CHAINS, J. Imray.—(*M. L. A. de Briey, Paris.*)
3017. CANDLE-WICKS, J. Imray.—(*La Société Joly et Compagnie, Paris.*)
3018. SECURING CORKS in BOTTLES by WIRE, F. G. Riley, London.
3019. RESERVOIR PEN SOCKET and HOLDER, L. B. Bertram, Bayswater.
3020. FIRE-BOXES, H. Pataky.—(*H. Hempel, Germany.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

2878. HYDRAULIC CRANK, J. C. Müller, Paris.—*9th June*, 1883.
2903. PRINTING, &c., PRESSES, M. Gally, New York, U.S.—*11th June*, 1883.
2904. WOOD SCREWS, B. H. Lake, London.—Com. from H. A. Harvey, Orange, U.S.—*11th June*, 1883.
2916. CAR AXLE-BOXES, H. J. Haddan, London.—A communication from J. A. Hamilton, New York, U.S.—*12th June*, 1883.
2928. MOULDING, &c., MACHINES, W. R. Lake, London.—A communication from O. R. Chase, Boston, U.S.—*12th June*, 1883.
2952. STEAM BOILERS, W. R Lake, London.—Com. from A. H. Crockford, Newark, U.S.—*13th June*, 1883.

Patents on which the Stamp Duty of £50 has been paid.

2374. RAILWAY, &c., RAILS, H. A. Fletcher, Whitehaven.—*11th June*, 1880.
2554 STEAM BOILERS, G. E. Vaughan, London.—*23rd June*, 1880.
2604. LIGHTING and HEATING APPARATUS, J. T. C. Thomas, London.—*26th June*, 1880.
2387. ELECTRIC TELEGRAPHS, Sir C. T. Bright, London.—*12th June*, 1880.
2389. FIRE-ARMS, E Nagant, Liège.—*12th June*, 1880.
2395. PRESERVING MEAT, &c., H. A. Dufrené, Paris.—*12th June*, 1880.
2432. SHIPS' BINNACLES and LAMPS, J. M. Sim, London.—*16th June*, 1880.
2462. EXPANSION GEAR of STEAM ENGINES, A. Dobson, Belfast.—*18th June*, 1880.
2638. STEAM BOILERS, S Fox and D. Greig, Leeds.—*28th June*, 1880.
2446. PREPARING and DECOLOURING JUTE, &c., J. J. Sachs, Manchester.—*16th June*, 1880.
2453. ELECTRIC APPARATUS, J. C. Mewburn, London.—*17th June*, 1880.
2536. RACK PULLEYS, E. and C. Showell and J. Empson, Birmingham.—*22nd June*, 1880.
2437. ROOF TRUSSES and FASTENERS, H. P. Holt, Leeds.—*16th June*, 1880.
2469. PAPER and other BAGS, J. Nichols, Ashford.—*18th June*, 1880.
2488. STOPPERS for BOTTLES, J. Lamont, Glasgow.—*19th June*, 1880.
2972. KNEADING or MIXING DOUGH, &c., T. Lindop, Middlewich.—*19th July*, 1880.

Patents on which the Stamp Duty of £100 has been paid.

2416. DESKS and SEATS, J. Johnstone, Bradford.—*12th June*, 1876.
2429. TURN-WREST or RIGHT-AND-LEFT PLOUGHS, W. H. Sleep, Crofthole.—*12th June*, 1876.
2566. EFFECTING INCREASED SECURITY to LOCKS, &c., J. M. Hart, London.—*21st June*, 1876.
2497. CONTROLLING, &c., the SUPPLY of WATER, A. Tylor, London.—*16th June*, 1876.
2499. INSERTING and CLINCHING WIRE STAPLES in the BACKS of BOOKS, &c., W. R. Lake, London.—*16th June*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition, 6th July*, 1883.)

718. CRYSTALLISED SUGAR, G. W. von Nawrocki.—A communication from K. Sakovicz and D. Rosenblum, Warsaw, Poland.—*9th February*, 1883.
726. FURNACE BARS, F. Livet, London.—*9th February*, 1883.
730. FURNACES, J. H. Selwyn and R. Walker, London.—*9th February*, 1883.
733. WHEELS, R. R. Gubbins, London.—*9th February*, 1883.
762. FLUSHING URINALS, A. Codd, London.—*12th February*, 1883.
774. SPINNING and DOUBLING FIBROUS MATERIAL, W. and C. G. Bracewell and A. Pilkington, Barnoldswick.—*12th February*, 1883.
776. SELF-ACTING EXCAVATORS, T. Whitaker, Horsforth.—*12th February*, 1883.
812. DOMESTIC STOVES and GRATES, H. Thompson, London.—*14th February*, 1883.
813. FASTENINGS for BOOTS, &c., F. J. Brougham—Com. from G. Klotz, Belgium.—*14th February*, 1883.
850. ELECTRICAL SELF-REGISTERING MONEY TILLS, B. W. Webb, London.—*16th February*, 1883.
852. STOPPERING BOTTLES, J. C. Schultz, London.—*16th February*, 1883.
871. INCANDESCENT LAMPS, O. E. Woodhouse, F. L. Rawson, and W. H. Coffin, London.—*16th February*, 1883.
877. BILLIARD TABLES, J. Reap, Grove Park.—*17th February*, 1883.
910. CONCENTRATING, &c., WINES, S. Pitt.—A communication from the Compagnie Industrielle des procédés Raoul Pictet, Paris.—*19th February*, 1883.
980. TREATING STEEL INGOTS, G. J. Snelus, Workington.—*22nd February*, 1883.
1045. MANUFACTURE of COKE, W. W. Pattinson, Felling.—*27th February*, 1883.
1092. PREPARATION of DECOCTIONS, E. G. Brewer.—A communication from MM. Malen and Deglise, Paris.—*28th February*, 1883.

1137. BREAK-DOWN GUNS, W. Knobbs, London.—2nd March, 1883.
1226. ANCHORS, C. Mace, Sunderland.—7th March, 1883.
1334. SLIDE VALVES, A. J. Boult.—A communication from W. T. Reaser and C. R. Stein, Madison, U.S.—13th March, 1883.
1380. PREPARING PICTURES, &c., R. Brown, R. W. Barnes, and J. Bell, Liverpool.—15th March, 1883.
1604. HEATING and COOLING FLUIDS, W. A. G. Schönheyder, London.—30th March, 1883.
1813. CARRIAGE WHEELS, B. J. B. Mills.—A communication from C. Dégrange, France.—10th April, 1883.
2231. PRODUCING MATERIAL for STEREOTYPE MATRICES, L. Possett, and H. Schimansky, Berlin.—2nd May, 1883.
2285. STEAM PUMPS, F. and S. Pearn and T. Addyman, Manchester.—5th May, 1883.
2308. HEATING or COOLING LIQUIDS, J. Price, jun., Liverpool.—7th May, 1883.
2410. TREATING WOOD for SEASONING, J. B. Blythe, Bordeaux.—12th May, 1883.
2427. MANUFACTURE of SUGAR, J. Görz, Berlin.—12th May, 1883.
2471. EVER-POINTED PENCIL CASES, &c., W. Wiley, Birmingham.—17th May, 1883.
2482. ELECTRO-MOTIVE ENGINE, A. Browne, London.—17th May, 1883.
2494. MULTIPLE CYLINDER ENGINES, P. Brotherhood, Lambeth.—18th May, 1883.
2504. IRON and STEEL, T. Griffiths, Abergavenny.—19th May, 1883.
2510. SPINNING SPINDLES and their BEARINGS, A. M. Clark.—A communication from A. R. Sherman, Pawtucket, U.S.—19th May, 1883.
2511. OBTAINING MOTIVE POWER, A. Vacherot, Sutton.—19th May, 1883.
2523. EXTINGUISHING FIRES, V. von Trotha.—Com. from V. von Schlippe, Moscow.—21st May, 1883.
2878. HYDRAULIC CRANK, J. C. Müller, Paris.—9th June, 1883.

(*Last day for filing opposition, 10th July, 1883.*)

787. BREAKING PIG IRON, J. Evans, Graythorne, and S. Mason, Leicester.—13th February, 1883.
791. SECONDARY, &c., BATTERIES, T. Rowan, London.—13th February, 1883.
792. DYNAMO-ELECTRIC MACHINES, T. Rowan, London, and S. Williams, Newport.—13th February, 1883.
796. CONSTRUCTION, &c., of PARTS of VELOCIPEDES, W. J. Spurrier, Birmingham.—13th February, 1883.
803. WALLS for BUILDINGS, W. Mullett, Brierley Hill.—14th February, 1883.
807. PLASTIC COMPOUND, O. Schreiber, London.—14th February, 1883.
808. TREATING FELT, J. Isherwood, Denton.—14th February, 1883.
828. COMPRESSED AIR MOTORS, R. Bolton.—A communication from C. W. Potter, U.S.—15th February, 1883.
834. MATCHES, &c., G. W. von Nawrocki.—A communication from Messrs. F. Gerken and G. Goliasch and Co., Berlin.—15th February, 1883.
837. COFFEE CUPS, C. D. Abel.—A communication from M. D. Pasvouri, Asia Minor.—15th February, 1883.
845. MANUFACTURE of PIPES, H. Tugby, Woodville.—15th February, 1883.
853. ROCK DRILLS, J. W. Larmuth and R. B. Howarth, Pendleton.—16th February, 1883.
863. MORTICE LOCKS, A. W. Pocock, Wandsworth.—16th February, 1883.
870. PIANOFORTES, C. Camin, Berlin.—16th February, 1883.
872. SOFTENING, &c., HIDES or SKINS, A. M. Clark.—Com. from J. L. Moret, Paris.—16th February, 1883.
882. BOOT and SHOE TIPS, J. Foster, Kettering.—17th February, 1883.
884. PRESERVING SMOKED FISH, H. J. Haddan.—A communication from O. Syllwasschy, Leipzig.—17th February, 1883.
895. STARCHING COLLARS, &c., S. Barrett, Keighley.—19th February, 1883.
905. FIRE GRATES, I. Dunbar, Coalbrookdale.—19th February, 1883.
914. KEYLESS WATCHES, C. Lange, London.—19th February, 1883.
928. POINTING and FIRING of GUNS, H. J. Haddan.—Com. from A. Bouilly, France.—20th February, 1883.
948. SEWING MACHINES, W. Jones, Guide Bridge, and H. Gamwell, Liverpool.—21st February, 1883.
959. HARNESS, &c., J. G. Tongue.—A communication from D. Curtis, Madison, U.S.—21st February, 1883.
972. SEPARATING LIQUIDS from SOLID MATTERS, H. J. Haddan.—A communication from Gaillet and Huet, France.—22nd February, 1883.
1025. HYDRAULIC MACHINERY, W. R. Lake.—Com. from C. Jouffray, France.—24th February, 1883.
1041. SURFACE CONDENSERS, R. Norton, Newcastle-on-Tyne, and J. B. Edmiston, Liverpool.—27th February, 1883.
1055. WHITE LEAD, L. Brumleu, Wrexham.—27th February, 1883.
1060. GAS MOTOR, F. von Martini, Switzerland.—27th February, 1883.
1172. SECURING, &c., the ECCENTRICS on CRANK-SHAFTS of LOCOMOTIVES, F. Holt, Derby.—5th March, 1883.
1207. FILTRATION, W. R. Lake.—A communication from J. W. Hyatt, Newark, U.S.—6th March, 1883.
1229. PRODUCING PERMANENT COLOURED PHOTOGRAPHIC CARD PICTURES, A. H. Dawes, Windermere.—7th March, 1883.
1420. REFRIGERATING or COOLING AIR, G. H. Lloyd, Birmingham.—17th March, 1883.
1431. BREECH-LOADING REPEATING FIRE-ARMS, B. Burton, London.—19th March, 1883.
1482. MEASURING, &c., the SPEED and DIRECTION of ROTATION of SHAFTS, A. C. Campbell, Blythswood, and W. T. Goolden, London.—21st March, 1883.
1495. CUTTING MACHINE SCREWS, W. P. Thompson.—Com. from H. H. Taylor, Detroit.—21st March, 1883.
1529. SKATES, W. P. Thompson.—A communication from E. H. Barney, Springfield.—24th March, 1883.
2069. LOCKING APPARATUS, W. P. Thompson.—Com. from F. Flint, Cincinnati, U.S.—24th April, 1883.
2184. COLOURING MATTER, H. O. Miller, Moscow.—30th April, 1883.
2234. SAFETY APPARATUS for DETACHING, &c., SHIPS' BOATS, J. Linkleter, Tynemouth.—2nd May, 1883.
2381. BUOYANT CONTRIVANCES for LIFE-SAVING, &c., F. W. Brewster, London.—10th May, 1883.
2459. DOMESTIC FIRE-ESCAPE, T. Hale, Claydon.—16th May, 1883.
2469. SEPARATION, &c., of the ALKALI used in the EXTRACTION of CRUDE CARBOLIC ACID from COAL TAR, &c., J. Lane, Elland, and D. V. Steuart, Manchester.—17th May, 1883.
2520. COUPLING, &c., APPARATUS, W. Vaux, Bradford.—21st May, 1883.
2551. FISHING REELS, D. Slater, Newark-upon-Trent.—22nd May, 1883.
2552. SIZING MACHINES, J. Dugdale, Blackburn.—22nd May, 1883.
2558. WEIGHING MACHINES, W. P. Thompson.—Com. from J. Stevens, Neenah.—22nd May, 1883.
2903. PRESSES FOR PRINTING, &c., M. Gally, New York.—11th June, 1883.
2904. MACHINES for the MANUFACTURE of WOOD SCREWS, H. H. Lake.—A communication from H. A. Harvey, Orange, U.S.—11th June, 1883.
2916. CAR AXLE-BOXES, H. J. Haddan.—Com. from J. A. Hamilton, New York.—12th June, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 15th June, 1883.*)

5936. "PUTTING-OUT," &c., OPERATIONS in the MANUFACTURE of LEATHER, W. R. Lake, London.—12th December, 1882.
6010. COVERINGS for WIRE ROPES, &c., E. A. Brydges, London.—16th December, 1882.
6020. TELEPHONIC APPARATUS, G. L. Anders and J. B. Henck, jun., London.—16th December, 1882.
6022. PRODUCING MONALCOHOLISED HYDRIC BASES, W. A. Barlow, London.—16th December, 1882.
6028. TELEPHONIC APPARATUS, W. R. Lake, London.—16th December, 1882.
6029. COUPLING VEHICLES, H. P. Houghton, Manchester.—18th December, 1882.
6031. PIANOFORTES, W. Thomas, London.—18th December, 1882.
6037. FINISHING TEXTILE FABRICS, L. E. Lezeau-Coudrais, London.—18th December, 1882.
6040. WAGONS, H. C. Bull, Liverpool.—18th December, 1882.
6042. CLEARING SNOW from RAILWAYS, &c., E. Barnes, Ulverstone.—18th December, 1882.
6049. WATER CLOSETS, R. H. Leask, Dublin.—19th December, 1882.
6051. SCREWING MACHINES, S. Dixon, Salford.—19th December, 1882.
6052. MAKING PAPER BAGS, E. K. Dutton, Manchester.—19th December, 1882.
6075. INCANDESCENT ELECTRIC LAMPS, L. A. Groth, London.—20th December, 1882.
6077. TIPS for BOOTS and SHOES, L. A. Groth, London.—20th December, 1882.
6078. WINDOW BLIND, L. A. Groth, London.—20th December, 1882.
6082. HAND SHEARS, E. Nunan, London.—20th December, 1882.
6091. FURNACES, E. Bennis, Bolton.—20th December, 1882.
6096. PENCIL, &c., HOLDERS for COMPASSES, H. J. Haddan, London.—21st December, 1882.
6106. SELF-ACTING and ADJUSTABLE CLUTCHES, J. S. Taylor and S. W. Challen, Birmingham.—21st December, 1882.
6114. PHOTOMETRIC APPARATUS, S. H. Emmens, London, and J. Munro, Croydon.—22nd December, 1882.
6135. KIERS, J. Dimmock, Over Darwen.—23rd December, 1882.
6167. FIRE-ARMS, A. W. L. Reddie, London.—26th December, 1882.
6171. VACUUM BRAKE APPARATUS, J. Gresham, Salford.—27th December, 1882.
6195. ILLUMINATION of LIGHTHOUSES, J. R. Wigham, Monkstown.—28th December, 1882.
6200. DRYING STARCH, &c., W. R. Lake, London.—28th December, 1882.
6213. MATCH-BOXES, J. Darling and J. J. Long, Glasgow.—29th December, 1882.
6216. TUBULAR BOILERS, J. Armer, Dartford.—29th December, 1882.
6241. MACHINE TOGGLE, A. M. Clark, London.—30th December, 1882.
19. GAS MOTOR ENGINES, P. F. Forest, Paris.—1st January, 1883.
50. SEIZING, &c., LIGHT OBJECTS, A. M. Clark, London.—3rd January, 1883.
54. SEWING MACHINES, W. E. Gedge, London.—4th January, 1883.
61. GAS HEATING ARRANGEMENTS, E. A. Brydges, Germany.—4th January, 1883.
66. SHADES for LAMPS, &c., J. H. Johnson, London.—4th January, 1883.
193. CENTRIFUGAL MACHINES, J. E. Meyer, Copenhagen.—12th January, 1883.
216. ROTARY PUMPS, &c., E. B. Donkin, London.—13th January, 1883.
250. COOLING LIQUIDS, H. J. Haddan, London.—16th January, 1883.
351. COUPLING, &c., RAILWAY WAGONS, S. A. Croft and R. Lodge, Manchester.—22nd January, 1883.
460. DRYING APPARATUS, E. A. Brydges, Germany.—29th January, 1883.
490. SECURING WADS in CARTRIDGES, H. J. Haddan, London.—30th January, 1883.
563. ORGANS, &c., J. B. Hamilton, London.—1st February, 1883.
658. BEDSTEADS, &c., G. Lowry, Salford.—6th February, 1883.
1042. MACHINES for MAKING CIGARS, &c., A. M. Clark, London.—27th February, 1883.
1377. SPANNERS, J. Robson and J. W. Tingle, Sheffield.—15th March, 1883.
1424. HANDLES for KNIVES and FORKS, H. Walker, Sheffield.—17th March, 1883.
1442. BOGIES, J. Patterson, Workington.—19th March, 1883.
1637. TAPS, W. A. Todd, Folkingham.—31st March, 1883.
1677. GAS MOTOR ENGINES, C. D. Abel, London.—3rd April, 1883.
1689. WIRE ROPE or CABLE, T. Seale, San Francisco, U.S.—4th April, 1883.
1734. EGG BEATERS, A. H. Frost, and F. Earl, St. Ives.—6th April, 1883.
1945. PILE FABRICS, W. R. Lake, London.—17th April, 1883.
1983. SUBTERRANEAN ELECTRIC CABLES, H. J. Allison, London.—19th April, 1883.
2081. UMBRELLAS, &c., O. Imray, London.—24th April, 1883.

(*List of Letters Patent which passed the Great Seal on the 19th June, 1883.*)

5907. TYPE-DRESSING MACHINES, H. J. Haddan, London.—11th December, 1882.
6079. SHIPS for FACILITATE PROPULSION, F. H. F. Engel, Germany.—20th December, 1882.
6084. REGULATORS for STEAM ENGINES, E. Edwards, London.—20th December, 1882.
6107. HAT LININGS, W. H. Knowles and J. Faulkner, Denton, and R. I. Metcalfe and W. N. Raines, Dukinfield.—21st December, 1882.
6109. OVENS HEATED by GAS, W. A. Crommelin, J. Lees, H. Spain, and W. H. Thompson, London.—21st December, 1882.
6115. COUPLING, &c., RAILWAY CARRIAGES, J. Anderson and J. Darling, Glasgow.—22nd December, 1882.
6120. TEACHING GEOGRAPHY, &c., A. J. Boult.—22nd December, 1882.
6134. PRESERVING ANIMAL, &c., MATTER, J. Townsend, Glasgow.—23rd December, 1882.
6136. MOTIVE-POWER ENGINES, J. A. B. Bennett, King's Heath, and B. P. Walker, Birmingham.—23rd December, 1882.
6140. TRACTION ENGINES, E. Foden, Sandbach.—23rd December, 1882.
6156. SASH FASTENERS, J. E. Cope, Birmingham.—23rd December, 1882.
6160. SEWING MACHINES, A. Guillaume and A. Lambert, Belgium.—23rd December, 1882.
6166. LITTER for USE in STABLES, H. Symons, Totnes.—26th December, 1882.
6172. KILNS, H. Knowles, Woodville.—27th December, 1882.
6193. INCANDESCENT ELECTRIC LAMPS, T. J. Handford, London.—28th December, 1882.
6210. PURIFYING OIL, W. R. Lake, London.—19th November, 1882.
6222. COCKS or VALVES, A. Bradshaw, Accrington.—29th December, 1882.
6223. SPINNING MACHINERY, N. Macbeth and R. N. Cottrill, Bolton-le-Moors.—30th December, 1882.
6237. ELECTRIC LAMPS, &c., W. R. Lake, London.—30th December, 1882.
18. LOCOMOTIVE ENGINES, H. Simon, Manchester.—1st January, 1883.
26. SPINNING and WINDING, F. Jenkin, Edinburgh.—2nd January, 1883.
35. REEL FOR COILING WIRE ROPES, W. H. Harfield, London.—2nd January, 1883.
67. GOVERNORS of STEAM ENGINES, R. E. B. Crompton, London, and J. W. Kempster, Chelmsford.—4th January, 1883.
252. RAILWAY CAR BRAKES, H. J. Haddan, London.—16th January, 1883.
262. CORK JACKETS, &c., H. H. Lake, London.—16th January, 1883.
290. HOLDERS for CORDS, J. Sprague, Upper Norwood.—18th January, 1883.
817. BRASS BOBBIN WINDING ENGINES, J. Mosley, New Basford.—14th February, 1883.
846. SADDLE-BAR, M. Macleod, Malmesbury.—15th February, 1883.
960. ENGINES, F. M. Rogers, London.—21st February, 1883.
1574. LAVATORIES, &c., A. F. Morrison, Manchester.—28th March, 1883.
1603. CUTTERS EMPLOYED in HORIZONTAL, &c., MACHINES, J. Wade, Halifax.—30th March, 1883.
1675. COMPOUND PLATES, F. A. Krupp, Germany.—3rd April, 1883.
1740. APPLYING DABBING BRUSHES to COMBING MACHINES, H. Portway, Bradford, and J. C. Walker, Shipley.—6th April, 1883.
1758. AMALGAMATING APPARATUS, A. K. Huntington and W. E. Koch, London.—7th April, 1883.
1797. STAMPING, &c., MINERALS, J. H. Johnson, London.—10th April, 1883.
1816. PRODUCING FRESH WATER by DISTILLATION, J. Kirkaldy, London.—10th April, 1883.
1819. STEAM BOILERS, W. R. Lake, London.—10th April, 1883.
1912. CARBONATE of STRONTIA, W. A. Rowell, Newcastle-on-Tyne.—14th April, 1883.
1913. DRIVING GEAR, F. Jenkin, Edinburgh.—14th April, 1883.
1920. ARMOUR PLATES, J. W. Spencer, near Newcastle-on-Tyne, and W. Bagshawe, Newcastle-on-Tyne.—16th April, 1883.

List of Specifications published during the week ending June 16th, 1883.

3767, 2d.; 4103, 2d.; 4491, 2d.; 4543, 2d.; 4693, 6d.; 4802, 6d.; 5047, 8d.; 5061, 4d.; 5065, 2d.; 5066, 6d.; 5075, 6d.; 5076, 4d.; 5084, 1s.; 5086, 6d.; 5088, 6d; 5090, 4d.; 5091, 2d.; 5092, 2d.; 5093, 2d.; 5094, 2d.; 5095, 6d.; 5097, 2d.; 5098, 2d.; 5099, 4d.; 5104, 4d.; 5105, 10d.; 5108, 6d.; 5114, 6d.; 5117, 6d.; 5118, 2d.; 5122, 1s. 2d.; 5123, 6d.; 5124, 6d.; 5126, 4d.; 5127, 6d.; 5130, 6d.; 5131, 6d.; 5132, 8d.; 5134, 6d.; 5138, 6d.; 5154, 6d.; 5178, 6d.; 5189, 6d.; 5245, 6d.; 5301, 8d.; 5382, 6d.; 5492, 6d.; 129, 1s. 2d.; 424, 6d.; 1066, 6d.; 1135, 6d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for* THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.

3767. DECORATING GLASS, WOOD, &c., *T. Markham, Manchester.—8th August*, 1882.—(*Provisional protection not allowed.*) 2*d.*

Ferns, flowers, or leaves are secured to glass, wood, or stone, and then covered with transparent waterproof varnish.

4103. KNITTING MACHINES, *P. B. Standring, Belgium.—28th August*, 1882.—(*Provisional protection not allowed.*) 2*d.*

The machine is designed to allow of two articles being made at the same time, while either part of the machine can be thrown out of work as desired.

4491. DRIP COURSE BRICKS, *W. H. Cooper, Regent's Park.—20th September*, 1882.—(*Provisional protection not allowed.*) 2*d.*

This relates to the dimensions and form of bricks to form "weathering" to projecting mouldings in brickwork as well as brick walls, &c.

4693. EXCAVATING EARTH, *J. F. Sang, Cheapside.—3rd October*, 1882. 6*d.*

One or more spades or cutters are arranged to slide vertically in a frame, being actuated by rack and pinion, so as to enter and slide off the earth, which falls into and is lifted by the buckets of an adjustable elevator.

4802. APPARATUS TO BE APPLIED TO THE HOLES OF CASKS OR BARRELS, *W. H. Beach, Stafford.—9th October*, 1882. 6*d.*

This relates to means for closing the tap holes of casks when the tap is withdrawn, and it consists in the use of a valve, which is forced to its seat by a spring, and which by the introduction of the tap is caused to leave its seat.

5047. LOCOMOTIVE AND PORTABLE ENGINES, &c., *M. P. W. Boulton, Oxford, and E. Perrett, Westminster.—23rd October*, 1882. 8*d.*

This relates to means of supplying motive power to locomotive and portable engines, and consists in the employment of the expansion of atmospheric air by heat in the manner described in patent No. 1788, A.D. 1882. The air is heated in a strong vessel containing fire-brick previously heated by combustion of fuel or the passage of heated gases from a furnace, such air being then utilised for driving a caloric or hot air engine. Locomotive and tram engines are formed with three pairs of wheels, the axle of the central path being carried in the side frames in the usual manner, whilst the axles of the wheels at either end are carried in a swinging frame pivotting on a centre between the axle and the central pair of wheels, the two frames being connected together.

5061. INJECTOR FOR WATER, LIQUIDS, AIR, GAS, AND VAPOURS, *W. H. Beck, London.—24th October*, 1882.—(*A communication from P. H. and F. A. Michaux, and A. C. Raingeard, Paris.*)—(*Not proceeded with.*) 4*d.*

According to this invention the retaining valve, instead of being opened by the direct impact of the jet, is opened by transforming the same into an indirect pressure accumulated by the work of several seconds, and it consists in the use of a pressure reservoir instead of the usual diverging tube or canal of the injector.

5065. APPARATUS FOR SOLDERING, *A. J. Boult, London.—24th October*, 1882.—(*A communication from A. Leguay, France.*)—(*Not proceeded with.*) 2*d.*

This relates to apparatus for soldering the top or bottom and the body of metal cases, cans, or boxes, and it consists of a shaft with pulleys, each driving a block carrying one of the boxes. A bracket slides in a guide and carries the soldering bit heated by gas and supported so as to bear on the seam to be soldered.

5066. RATCHET WRENCHES, *L. Bagger, Washington, U.S.—24th October*, 1882.—(*A communication from G. W. Hight and D. H. Bailey, Nashville, U.S.*)—(*Complete.*) 6*d.*

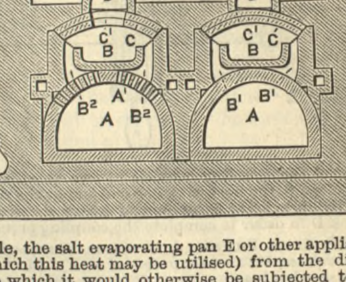
The lower end of the wrench bar is fastened to a handle, and at its top end forms a shoulder against which a face plate rests and is fastened to the bar. The face plate has an annular head corresponding with a head on the wrench bar, and between these two heads the ratchet wheel is inserted and has two slots in which movable jaws slide. It has also two standards through which a right and left-handed screw works, and actuates the two lips or parts of each pair of jaws. Two pawls are used, either of which can be thrown out of gear according to the side it is desired to work the wrench.

5076. MANUFACTURE OF COKE, *J. Jameson, Newcastle-upon-Tyne.—24th October*, 1882. 4*d.*

This relates to improvements on patent No. 1947, A.D. 1882, for extracting volatile products from the coking of coal, and it consists in supplying to the charge of coal a certain quantity of pitch. Also, in using an increased suction at intervals, to consolidate the coal in the lower part of the charge, and to extract a greater proportion of the heavy oils and pitch; also in heating gas to be supplied to the coke oven; also in the use of cold gas or steam to extinguish the oven. Other improvements are also described.

5075. MANUFACTURE OF COKE, &c., *P. Jensen, London.—24th October*, 1882.—(*A communication from Messrs. Beatus, Petersen, and Co., Copenhagen.*) 6*d.*

In the drawing A A are the coke ovens, having arched or vaulted tops; near the crown of these arched tops a series of perforations A^1 are formed at intervals apart. B is a tray-shaped receptacle above each coke oven A, for coals supported on either side by supporting walls B^1, the spaces between which wall form flues B^2, serving to conduct the heated products of combustion from the coke evens or retorts A, by the perforations A^1 to the tray B; C is the arch roof above the tray B; in which an aperture C^1 is formed, and through which the heated gaseous products pass; D shows the arched flue covering or shield above the aperture C^1 for the purpose of shielding, for



example, the salt evaporating pan E or other appliance (for which this heat may be utilised) from the direct heat to which it would otherwise be subjected to at this particular place. The heat passing out of the arched flue D enters another flue where it is caused to circulate by means of partitions, eventually passing by the chimney. The arched flue D has an aperture for admitting air to the products of combustion.

5084. TREATMENT OF COAL AND OTHER SUBSTANCES FOR OBTAINING AMMONIA, &c., *W. Young, Peebles, and G. T. Beilby, Midlothian.—25th October*, 1882. 1*s.*

The principal object is to produce ammonia or ammoniacal compounds from the nitrogen compounds in coal, peat, and similar bituminous or hydro-carbonaceous substances, and the conversion and utilisation of the combustible portion into a heating gas at one operation, and it consists in improvements on patents Nos. 1587, 2169, and 4284, A.D. 1881, and No. 1377, A.D. 1882. The claims are, First, obtaining ammonia from the nitrogen of substances, such as carbonaceous minerals, organic substances, tars from blast furnaces, tars from shale oil refining, or from the distillation of organic substances such as bone oil, by decomposing them directly by steam or steam and air at a suitable temperature and in the presence of excess of steam, this end being accomplished by the rapid presentation of a large surface of the nitrogenous substance to decomposing atmosphere of steam or steam and air; Secondly, the separation of ammonia or its salts from hot gases as they are produced, and without preliminary condensation, in the presence of a large volume of water vapour, and without condensation of the water vapour, by means of acid scrubbers kept at a suitable temperature; Thirdly, the process by which waste heat of gases from any retort or decomposing apparatus is made available to supply the whole or a portion of the water vapour required for the decomposition of nitrogenous substances into heating gas and ammonia; and Fourthly, the apparatus for effecting the above objects.

5086. PRINTING SURFACES FROM GELATINE RELIEFS, *R. Brown, R. W. Barnes, and J. Bell, Liverpool.—25th October*, 1882. 6*d.*

The object is to simplify the "Woodbury process," in which impressions of gelatine reliefs are reproduced upon lead surfaces by pressure, and it consists in imparting to lead or soft metal plates a true and even surface and thickness by roller pressure, and impressing into such prepared plate a gelatine relief by roller pressure, instead of by hydraulic pressure as hitherto. When the surface of the plate has been grained or roughed by the application of wire gauze to its surface, it may be used for printing with fatty inks.

5088. APPARATUS FOR MOULDING AND CASTING, &c., *J. and T. A. Boyd, Lanark, N.B.—25th October*, 1882. 6*d.*

The improvements are applicable to patent No. 1982, A.D. 1874, the object being to economise plant and secure accuracy and uniformity of articles cast. As applied to a pair of flasks, each consisting of an open frame with sides smooth, and having an internal taper which, when the flasks are put together, is continuous through both, so that both can be lifted from the mould. An improved mallet for tapping the flasks and pattern plates is also described.

5090. APPARATUS FOR DISCHARGING OIL UPON WAVES, *R. Rose, London.—25th October*, 1882. 4*d.*

This relates to an arrangement of pipes in a ship or vessel to which oil is supplied by a pump from a suitable reservoir, such pipes being fitted with nozzles fitted with cocks, so that the oil may be discharged as desired.

5091. CLEARING AND CLEANING TRAMWAY RAILS, *T. P. Evans, East Greenwich.—25th October*, 1882.—(*Not proceeded with.*) 2*d.*

A shoe is fitted on each side of the car, and is forced downwards by springs so as to clean the rails. The shoes can be lifted clear of the rails by suitable means.

5093. APPARATUS FOR DOMESTIC PURPOSES TO BE USED WITH GAS, *H. and T. A. Greene, London.—26th October*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to apparatus so connected with the alarm mechanism of a clock that at any given hour a gas stove will be lighted, and any food cooked or warmed automatically.

5094. USING ARGAND BURNERS, *H. and T. A. Greene, London.—26th October*, 1882.—(*Not proceeded with.*) 2*d.*

Attached to the fitting carrying the burner is a glass shade closed at bottom (except that a connection is made through it to the burner for the passage of gas), and extending up outside the chimney a certain height. The air to support combustion enters the shade at top, and in passing through the space between the chimney and the shade becomes heated before passing to the flame.

5095. GOVERNOR FOR REGULATING THE SUPPLY OF GAS, &c., *H. and T. A. Greene, London.—26th October*, 1882. 6*d.*

A vessel at top has an open tube inserted in the bottom and carried upwards a certain height. A water-tight vessel or float of a shape to leave a space covering the tube is inserted in the first vessel. Under the first vessel is a gas-box with an outlet pipe, and having a valve seating in the lower part. Near the top of the first vessel is a guide for a rod fitted with a valve at its lower end within the gas-box. A second gas-box is placed below the former, and to it the inlet pipe is attached. A suitable liquid is placed in the first vessel.

5104. COMPOUNDS FOR USE IN PLACE OF LEATHER, &c., *M. Bauer, L. Brouard, and J. Ancel, Paris.—26th October*, 1882. 4*d.*

This consists of gutta-percha vulcanised with sulphur, and either alone or mixed with other matters, depending on the uses for which the compound is required.

5114. TILTING CASKS, *E. Hogg, Gateshead-on-Tyne.—27th October*, 1882. 6*d.*

A light frame is placed with one end resting upon an abutment above the back end of the barrel, and at its front end a screwed rod works through a trunnion bush, when actuated by a suitable hand-wheel, the rear end of such rod having a hook to catch hold of the rear of the barrel. Arms extend downwards from the front of the frame and carry rollers which rest on the top of the barrel.

5117. COUPLINGS FOR RAILWAY CARRIAGES, &c., *T. Smith, Brockley.—27th October*, 1882. 6*d.*

The drawing shows the coupling in use, connecting together the two wagons. A is the end cross beam of the wagon which carries the coupling, and B the corresponding cross beam of the other wagon to which it is to be coupled. C and D are draw-hooks attached to the beams in the usual way, their shanks being provided with transverse holes at E and F. The main

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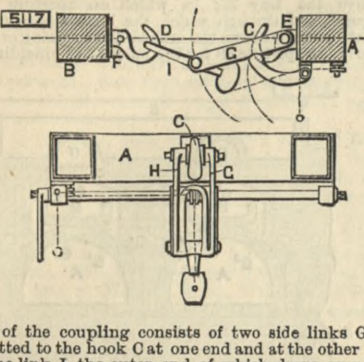

part of the coupling consists of two side links G H, pivotted to the hook C at one end and at the other end to the link I, the outer end of which drops over the hook D in order to complete the coupling process.

5118. Loom Pickers, *J. Challinor, Manchester.—27th October*, 1882.—(*Not proceeded with.*) 2*d*.

A wooden bearing piece slides upon the spindle and is secured to a metal piece with a cavity to receive a buffer.

5123. Drilling, Tapping, and Studding Machines, *J. Morris, Poplar.—27th October*, 1882. 6*d*.

The objects are to drill holes, thread them with a screwed plug tap, and to supply them with screwed stud bolts. The drill spindle is divided into two main parts, united by a sliding coupling, and is made to work in both directions by open and cross belts. The lower part of the spindle is also divided into two parts and provided with a coupling device, so formed that, when used for drilling pawls are caused to remain in gear with the boss portion of the coupling, but when used for tapping purposes the motion is reversed, and as soon as the tap is screwed to the bottom the pawls work out of gear. The motion is reversed, and the tap screws out. The drill spindle can be provided with a stud driver to screw studs into the tapped holes.

5124. Alarm Bells or Gongs for Doors, &c., *A. W. L. Reddie, London.—27th October*, 1882.—(*A communication from E. J. Masseron, Paris.*) 6*d*.

This relates to an alarm bell actuated by the turning or movement of the bolt or catch of the door to which it is attached. The bell consists of a shell, against which a rotating hammer is caused to strike a rapid succession of blows by means of suitable gearing arranged within the shell, such hammer being loosely pivotted in or connected with a block keyed on the shaft of pinion, which is connected by a train of gearing with a crank arm to which a direct pull or thrust is given by a link rod connected with the bolt of the lock.

5127. Bottle Envelopes, &c., *A. W. Abrahams, Notting Hill.—27th October*, 1882. 6*d*.

A sheet of wood, pasteboard, or other suitable flexible material has pieces cut out of one end of such size and shape as to permit the same to fit closely round the neck, while the uncut part fits closely round the body of the bottle. The envelope is secured in position by a cord or bands or rings.

5130. Apparatus for Carburetting Air, &c., *H. H. Lake, London.—27th October*, 1882.—(*A communication from L. F. A. Lascols, Paris.*) 6*d*.

The invention consists in an improved carburetter for converting air into illuminating gas by its passage through volatile oils, such carburetter consisting essentially of a closed vessel, in which the level of oil is kept level by means of pipes with capillary holes at their extremities, and also serving to prevent shocks by the sudden movement of the liquid in the pipes. The air enters by an inverted cup with oblique teeth at its circumference, and surmounted by a horizontal metal grating. The carburetter is immersed in a vessel of water to prevent cooling, and avoid overheating, and to obviate all risk of accident from leakage. A modification is described.

5131. Process of and Apparatus for Producing Coloured Photographs, *H. H. Lake, London.—27th October*, 1882.—(*A communication from J. Chaine, A. Durand, and S. de Chaligny, Lyons.*) 6*d*.

This relates to the fixing or rendering unchangeable of oil colour applied behind photographs, which have first been rendered transparent. The photograph is first treated in a hot bath, and rendered transparent, then placed on a heated table, and the colour applied, after which it is submitted to heat in an oven.

5132. Kilns for Burning Lime and Brick, &c., *S. de la G. Williams, Birmingham.—27th October*, 1882. 8*d*.

This relates to a special construction and arrangement of gas and air flues beneath the floors of the chambers of the kiln, and their combination with openings in such floor to supply gaseous fuel and air to be burned in the chambers. Flues and dampers are arranged for putting such chambers in communication with one another and with the chimney stack, for the purpose of cooling one chamber after the contents have been sufficiently operated upon, and heating the air supplied to the next and succeeding chambers.

5134. Apparatus for Admitting and Regulating the Blast of Air in Cupolas, &c., *C. Landreth and I. Renis, Spain.—27th October*, 1882. 6*d*.

The tuyeres are placed in groups at intervals round the circumference of the cupola, and each group arranged one above the other, either in regular tiers or irregularly disposed. In front of each group a blowing chamber is fixed, and receives air from the blowing machine by a pipe. Through the back of each chamber are openings opposite the tuyeres, and over each is arranged a sliding register, with a hole covered by glass, through which the state of the furnace can be inspected. In front of each tuyere a register or valve is also fitted to regulate the amount of air admitted.

5138. Self-acting Lubricators, *G. Beletrez, Levallois-Perrett, Seine, France.—28th October*, 1882.—(*Partly a communication from I. Duballe, Paris.*) 6*d*.

According to one arrangement the apparatus is com-

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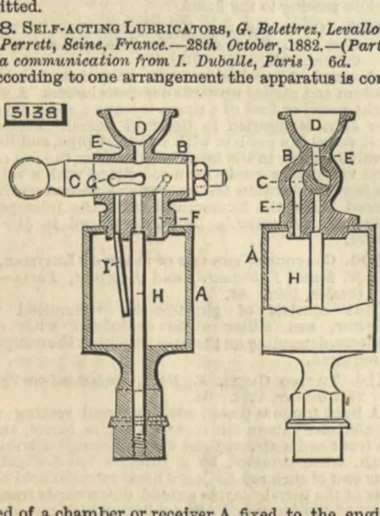

posed of a chamber or receiver A fixed to the engine cylinder in any convenient manner. The shell B of the tap or cock in the lubricator is screwed to the upper part of the receiver A. The tap or cock C is turned so as to put the receiver A into communication with the funnel D by an orifice E—that is to say, when the tap handle is turned upwards the receiver is in communication with the outer air by a conduit F which permits the filling of the receiver with the lubricant. When the tap or cock is in a horizontal position the apparatus is put in action and the lubrication is effected because a hollowed part G in the tap puts two conduits, H and I, into communication, so that the steam entering through the steam conduit at H passes into the receiver A through the other conduit and condenses in the receiver, causing the lubricants to flow in the reverse direction through the same conduits.

5154. Noiseless Motion with Improved Action to Common Flat Strainers for Paper Pulp, *W. Muirhead, near Paisley, N.B.—30th October*, 1882. 6*d*.

This consists in forming the cams used to give the jog action to flat strainers with an undulating surface instead of in the form of a ratchet wheel, and upon this surface the horns of the frame are supported, and such surface guides both the upward and downward movements of the strainer frame springs, act upon the horns of the frame, so as to keep them always in contact with the cams.

5178. Folding Tables, *F. F. Atkinson, New York.—31st October*, 1882. 6*d*.

This consists in the combination with a table top of a pair of legs hinged at one end thereto, a second pair pivotted near their centre to the first pair, a pair of spring clasps, a pair of metal supporters backing such clasps, and a recessed or countersunk cross bar connecting the upper ends of the second pair of legs, the spring clasps being adapted to enter the recesses of the bar, and prevent end movements.

5189. Cleaning, Dressing, and Drying Currants, &c., *D. Fox and A. Wheeler, Darlington.—31st October*, 1882. 6*d*.

The fruit to be cleaned is placed in a wirework cylinder which is caused to rotate in a tank of water. The fruit is then placed, in a centrifugal apparatus, in which it is again subjected to the action of a stream of water, and then dried.

5245. Spinning, Doubling, and Twisting, *H. B. Barlow, Manchester.—3rd November*, 1882.—(*A communication from E. C. A. Masson, Paris.*) 6*d*.

The object is to drive spindles of machines for spinning, doubling, and twisting fibre simultaneously at an uniform speed by one belt or cord passing over the pulleys of a number of spindles. An endless cord or belt actuated by suitable means is caused to run in contact with pulleys on the spindles by the use of suitable guide pulleys, which regulate the tension of the cord or belt.

5301. Manufacture and Ornamentation of Metallic Bedsteads, &c, *R. G. Hodgetts, Birmingham.—6th November*, 1882. 8*d*.

This relates to the ornamentation of bedsteads by the use of pieces of fluted or ornamental metallic tubing or tubular pieces of glass or other material in combination with metallic mounts or collars and a screw cap, such parts being secured together and to the pillar or other part of the bedstead.

5382. Manufacture of Lace, *L. Marceuil, Paris.—11th November*, 1882. 6*d*.

The object is to manufacture lace identical with hand-made lace, and it relates particularly to improvements on machines described in patents No. 852, A.D. 1872, and No. 4101, A.D. 1876. The machine is arranged to manufacture several widths or pieces at one time, each piece being formed by the threads from one of several superposed tiers of bobbin carriers, each arranged in the form of a segment of a circle, towards the centre of which the threads are directed and the lace formed by interlacing or crossing them according to the design required. The spindles supporting the bobbin carriers produce this crossing, and pushers serve to bring the crossings against the work already formed. Two rods act independently of each other to produce the necessary movements of each spindle, and are governed by a pin fixed to a parallel motion actuated by a jacquard placed at the upper part of the machine.

12. Toilet Apparatus for Ships, *H. J. Haddan, London.—1st January*, 1883.—(*A communication from D. Wellington, Boston, U.S.*)—(*Complete.*) 6*d*.

This relates to a self-levelling wash bowl for use on ships; and consists principally in supporting it by a ball-and-socket joint, in combination with a weighted frame.

129. Apparatus for Cable Traction Railways or Tramways, *J. Imray, London.—9th January*, 1883.—(*A communication from S. H. Terry, Guthrie, U.S.*)—(*Complete.*) 1*s*. 2*d*.

This relates to grippers used on tramway cars to engage a travelling cable for propelling the car; to means of governing the cable; to means for simultaneously operating the grippers and car brakes; to means for actuating the car brakes, and to tracks and switches for cable way systems. The principal objects are, First, to form the gripper so that it is not only under the control of the operator from the platform, but can be automatically operated to release the cable, and pass a crossing cable or other obstruction; Secondly, to enable the gripper to be able to sway from side to side when engaged with the cable; Thirdly, to provide guards to release the gripper and lift it over any obstruction; Fourthly, to enable the gripper to be quickly attached and detached; Fifthly, to enable the gripper to be automatically released from the cable, in case of derailment of the car. Other improvements are also described. The inventor has seventy-four claims.

215. Breech-loading Cannon, *R. H. Brandon, Paris.—13th January*, 1883.—(*A communication from B. B. Hotchkiss, Paris.*) 6*d*.

This relates, First, to the arrangement of the part employed for opening and closing the breech described in patent No. 5435, A.D. 1881; and it consists in the use of two lever arms set at right angles to each other on the same shaft for operating the breech, so that the latter is opened and closed by the gunner pulling alternately each lever arm towards him. It consists, Secondly, in applying india-rubber to the shoulder piece for pointing the gun, so as to deaden the recoil against the shoulder, and also to increase the adherence of the shoulder of the gunner against the shoulder piece; Thirdly, to applying india-rubber to the trunnions, and to the pivot of a breech gun to deaden the recoil.

289. Arresting Sparks from Funnels, Flues, &c., *E. de Pass, London.—18th January*, 1883.—(*A communication from R. M. Bowling, Victoria.*)—(*Complete.*) 4*d*.

This consists of a cage to fit the top of the funnel or flue, the top and upper part of the sides being of wire gauze, and the bottom and lower part of the sides of sheet or cast iron. Inside the cage, over the top of the funnel, three concentric cylinders are placed, with spaces between them, and the outer cylinder has a cap with a few perforations through it. The two inner cylinders are flanged outwardly at bottom to connect them to supporting rods, and also to direct the draught. The upper part of the inner cylinders is perforated, and the middle one is also flanged inwardly at top.

358. Ships' Sleeping Berths, *H. H. Lake, London.—22nd January*, 1883.—(*A communication from the Huston Ship's Berth Company, Incorporated, Boston, U.S.*)—(*Complete.*) 6*d*.

This relates to a self-levelling ship's sleeping berth, the supporting frame of which is adjustable to adapt it for state-rooms of different lengths.

380. Printing and Bookbinding Machinery, *W. R. Lake, London.—23rd January*, 1883.—(*A communication from H. P. Feister and R. M. Hunter, Philadelphia, U.S.*)—(*Complete.*) 6*d*.

This comprises the arrangement of two impression cylinders with an endless chain of type forme carriages, such cylinders being arranged so as to print from alternate carriages, a suction device being arranged between the cylinders to transfer the paper when printed on one side from one cylinder to the other, whereby it is reversed for printing on the other side, such suction device operating intermittently so as to hold the paper only for an instant and prevent the drawing of its printed surface over the suction plate.

424. Ditching Machines, *R. Fowler, Leeds.—25th January*, 1883.—(*A communication from H. Carter and W. Rennie, Toronto.*)—(*Complete.*) 6*d*.

This consists in binding the plates forming the segmental rim of the elevating wheel by a ring arranged so that the plates are secured to the rim; in hinging the body piece of the bucket to the ring; in the form of the plates forming the rims; in the arrangement of the rollers located at the discharging spout of the elevating wheel, so that the body of the bucket is pushed back clear of the outer rim; in a spring cam bar arranged to force out the buckets as each approaches the ground; in forming the cam bar with a joint near the point where the buckets commence to raise the material, so as to permit the bucket to "give" to any obstruction; in forming and arranging the spade so that it moves on a circle of the wheel; in providing a plate to form a back to the buckets, and which is hinged at its bottom end to the spade; in providing such plate with flanges which can be moved when the machine is to be worked in sticky ground; in the manner of bracing the outer supporting wheels to the tongue; and in connecting the tongue to a block held adjustably in the front frame by a dog which may be worked from the driver's seat.

516. Apparatus for Building Arches or Domes, *W. R. Lake, London.—30th January*, 1883.—(*A communication from T. J. Lovegrove, Philadelphia.*)—(*Complete.*) 6*d*.

This consists in building arches to a curve, the length of each and every abscissa of which at any point is equal to the static load at such point multiplied by the leverage thereof, and divided by the maximum thrust, and also in the use of a template formed to a curve identical with the line of the arch.

704. Apparatus for Collecting and Removing Dust from Air which has Passed through Middlings Purifiers, &c., *W. R. Lake, London.—8th February*, 1883.—(*A communication from F. Prinz, Wisconsin, U.S.*)—(*Complete.*) 6*d*.

This relates to a dust collecting medium or fabric with separate compartments and means for isolating a portion of the latter, and permit air to pass into such portions through the end next to the device, and also means for inducing an air current through the isolated portion from one end and through the other portion from the other end. The dust collecting medium is in the form of a balloon or cage with separate compartments formed of flannel or other dust-collecting material.

742. Compressing Air by Successive Explosions of Combustible Gaseous Mixture, *J. Imray, London.—10th February*, 1883.—(*A communication from J. Schweizer, Paris.*)—(*Complete.*) 4*d*.

This relates to means for enabling the explosion of a gaseous mixture in a close vessel to be applied directly to compress air, and it consists in admitting a quantity of air to a strong vessel, and then a quantity of gas above it. This is exploded and compresses the air, forcing it past a check valve into a reservoir. The igniting orifice also serves for admission of air, and a valve is arranged to automatically cut off the gas supply when the pressure in the reservoirs attains a predetermined limit.

1051. Separating Starch, *S. Pitt, Sutton.—27th February*, 1883.—(*A communication from T. Müller and J. W. de Castro.*)—(*Complete.*) 1*s*.

This relates to improved processes and apparatus for separating bodies of different specific gravities, especially starch from starch water. The apparatus consists generally of a centrifugal machine the basket of which is driven from below, and which is provided with an adjustable cutter or removing apparatus, which after the bodies have been separated by the difference of specific gravity, and the centrifugal force excited upon them, will continuously remove that one of such bodies which is deposited toward the centre of the basket. The invention relates principally to the method of operating this cutter, and to its introduction within a centrifugal machine.

1053. Machines for Making Button Hole Linings, *A. J. Boult, London.—27th February*, 1883.—(*A communication from C. Dancel, New York.*) 6*d*.

This consists in the general arrangement and construction of machines for making button-hole linings, in which a die carrier and dies which move in an arc of a circle are used in combination with vibrating crimpers, and a reciprocating mandril around which the material is pressed by the crimpers.

1066. Metallic Strip-blanks for Barbed Fencing, *T. V. Allis, New York.—27th February*, 1883.—(*Complete.*) 6*d*.

This consists in forming barbed rods for fencing by rolling in flattened or elliptical grooves, in the bottom of which are recesses so as to form ribs, from which barbs are made by cutting out a portion thereof, and bending them in the desired directions.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

277,762. Hydraulic Mining Apparatus, *John H. Martin, Bidwell's Bar, Cal.—Filed January 10th*, 1880.

Brief.—A hydraulic nozzle is placed centrally in line with and at such distance from the lower end of an

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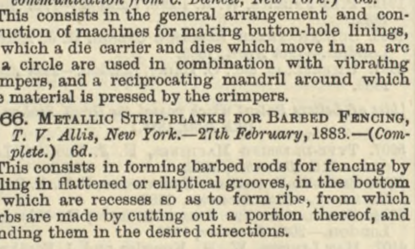

inclined flume as that masses only small enough to pass the flume will be permitted to enter. The flume has a lining to protect it and connects with an inclined riffle box.

278,022. Log Roller, *Lewis T. Kline, Alpena, Mich.—Filed February 8th*, 1883.

Claim.—(1) In a device for rolling logs from a skid to a saw carriage, a series of rocking arms

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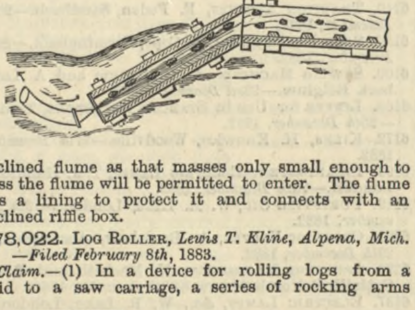

mounted on a horizontal shaft suitably journalled in said skids, an engine cylinder having its piston-rod suitably connected to the lower one of said rocking arms, the controlling mechanism, substantially as described. (2) In a device for rolling logs, one or more series of rocking arms, the rear one of which is raised by the depression of the remainder of the series and forms a stop against the stationary logs, and between which arms the moved log is carried, a horizontal shaft upon which all the rocking arms are mounted, a suitable frame or skid, and means for partially rotating and then reversing the shaft and arms, substantially as set forth. (3) In combination with the skids A, shaft D, and one or more series of rocking arms E F G, suitable actuating-power cylinder H, rod H^1, connected to arm G, and suitable valve levers, substantially as shown and described.

278,119. Dynamo-electric Machine, *George W. Fuller, Norwich, Conn.—Filed February 19th*, 1883.

Claim.—(1) In a dynamo-electric machine, the combination of the external system of annularly-arranged field magnets with armature coils the convolutions of which loosely surround an annular core of magnetic material which passes through all the armature coils, and all the parts of which core sustain unchanging polar relations to the field magnets substantially as and for the purpose set forth. (2) The combination, in a dynamo-electric machine, of armature coils with rotating field magnets, and an armature core capable of rotation independently of said armature coils, as and for the purpose set forth. (3) The combination, in a dynamo-electric machine, of systems of rotating field magnets and stationary armature coils with an annular armature core adapted to rotate independently of the coils which surround it, and having formed upon its face or faces transverse polar prominences substantially as and for the purpose set forth. (4) In an alternating current dynamo-electric machine, three systems of field magnets supported, respectively, in three circles upon the interior of a rotating shell, and forming a series of radially-arranged groups, each composed of three magnets, the three magnets of each group being of like polarity to each other, but of opposite polarity to that of the adjoining groups, and

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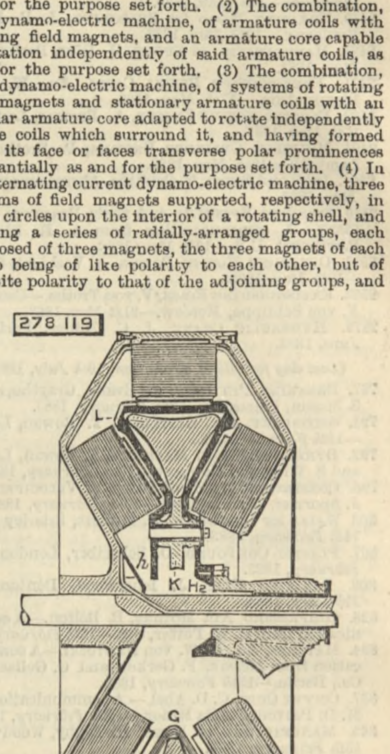

presenting their poles in close proximity to and parallel with the three sides respectively, of triangular coils transversely surrounding an endless bar or annular core, and supported upon a stationary frame, and connected with one or more operative circuits, in combination with contact makers and brushes electrically connected with the coils of the field magnets for conducting a current from an outside source to excite the field magnets. (5) In combination with the described systems of rotating field magnets and stationary armature coils, an annular armature core so supported or suspended as to be free to rotate, and having formed upon its faces transverse polar prominences, as and for the purpose set forth. (6) In combination with parallel systems of rotating field magnets, and with stationary armature coils, the floating armature core I, supported upon and centralised by the interiorly-placed friction rollers K K K, journalled in the stationary armature frame, suitably connected to and held in position by the front standard A of the machine, as and for the purpose set forth. (7) The stationary armature coils G, affixed to the rings H, and *h* of the stationary armature frame secured to or forming a part of the central hub H^2, as and for the purpose set forth.

CONTENTS.

The Engineer, June 22nd, 1883. PAGE

Attempts to produce stove castings in London have hitherto failed commercially. An engineering company have starteda foundry off the Goswell-road with a view to make their own castings, and rely upon the system of plate moulding to counter-balance the heavy expenses.