ings of the approaching storm, were also engulphed. These casualties were the result of the outbreak, as it may be called, of the storm, and were observed during daylight of the 12th by the crowds which thronged the shore. The gale increased in strength towards nightfall, and during the night its ravages were extended until about 700ft. of each pier were wholly destroyed, and the topmost tier of blocks throughout their entire length carried away, so that the sea, surmounting the rest of the structure, flowed easily into the harbour and caused the steam hopper barges, Hobart and Salisbury, which were at moorings within the breakwater, to founder, nineteen of their crews going down with them.

According to the latest received accounts, the piers, with the exception of the topmost run of blocks, are still intact from the shore to the point at which they curved to form the closing of the harbour, and it may be presumed, therefore, that from that portion of their length they were not exposed to the full force of the sea; but as they have so far yielded under the stress of a cyclone of what may be termed only half-cyclone power, it must be naturally fancied that they would altogether disappear were they exposed to a storm of the violence of that which occurred in 1872. It may, therefore, be truly said that the whole work will have to be re-commenced *de novo*, and it is extremely questionable, we should say, whether anything but the rubble mounds yet remaining can be utilised towards the re-construction; for it is evident that the béton blocks of 27 tons in weight, which may still remain *in situ*, are utterly inadequate to resist the violence of a cyclonic storm. Of course there will be strict inquiry as to the character of the design which has so signally failed, and caused so heavy a loss both of money and life. The assertions made by many engineers and others long in advance of this catastrophe are sufficient evidence that the experimental dimensions given by the designing engineer were foreseen to be utterly insufficient. The *Ceylon Observer*, commenting upon the occurrence, has thus written:—"Mr. Parkes' experiment in cheap work on a new principle of his own invention, hitherto unknown to marine engineers, has proved a failure. Mr. Kyle, the resident engineer of the Colombo works, long ago told us that if the Madras breakwater proved a success, it would practically revolutionise the system of breakwater construction, and we know that local critics have again and again censured the useless expense to which Sir John Coode was putting the colony by his slow, expensive, old-fashioned system of constructing our — Colombo—harbour wall. Such criticism will now be silenced for ever. Mr. Parke's work has ignominiously collapsed, while Sir John Coode's gives every promise of permanency."

It will be of interest, when considering the cause of failure, to inquire into the difference of construction adopted by Mr. Parke and Sir John Coode. At Colombo there are four courses of three blocks in each to the required depth. Each block is set or bonded nearly one-half its length over that of its neighbour, either over or under, turn about. In addition to this vertical band, there are five joggle holes running from top to bottom of the wall. As the work extended into deep water the wall on the rubble mound consisted of a uniform thickness of 34ft., consisting entirely of béton blocks. We are unaware of the exact dimensions of the corresponding work at Madras, which has so signally failed. We believe, however, it did not consist of more than two-thirds the thickness of the Colombo work. The courses had no transverse bond whatever, and the upper and lower ones were connected only by simple joggles. In fact, to quote *Ferguson's Ceylon Hand-book*, Mr. Parkes was of opinion that the bonding adopted at Colombo was "not at all necessary, and therefore constructs it without either vertical or lateral bonds, excepting in the case of the over and underlying blocks, where, we believe, they introduce a box-joggle in the centre of each bed of each block, top and bottom. But the inner and outer sections of the wall have no bond to keep them together, and enable them to cope with prolonged heavy weather."

A single failure, it is said, teaches us far more than do a thousand successes, and the unfortunate instance of the Madras breakwater will teach us a lesson not easily forgotten. It would be hard, indeed, if engineers were never to try and economise in work by departure from long-established customs. We should never progress did such a rule hold good in all cases; but probably in the case of marine work, where natural forces are so difficult to estimate with exactitude, it is better—as has been proved in the case of the Madras breakwater—to abide by rules established by known successes. The uplifting force of suddenly arrested sea waves, appears to have been altogether ignored in the design of the bonding described. The blocks at Colombo are, we believe, 50 tons in weight, while those which a comparatively trifling cyclone has scattered at Madras, weigh but 27 tons. But weight alone does not ensure stability against this force; the horizontal must be small compared with the vertical surfaces, or in relation to the weight, and Mr. Parke's blocks do stand on edge.

THE DITTON PUMPING ENGINES.

It is not improbable that many of our readers have passed with a glance the report by Mr. Cowper on the Ditton pumping engines, which appeared in our last impression on page 420. When they learn that the performance of those engines is, so far as we know, the best of which a trustworthy record exists, they will see that the report in question deserves more than a superficial examination. It is full of interest, and claims careful analysis. The engines are two in number, compound, with beams and fly-wheels. They are, in short, of the well-known rotative pumping type. The great peculiarity about them is that they are fitted with what was christened long since in the Navy, Cowper's "Hot-pot." In other words, the steam in the intermediate receiver is kept warm by fresh steam from the boiler. Each pair of engines consists of one high-pressure cylinder, 21in. in diameter and 5ft. 6in. stroke; and one low-pressure cylinder, 36in. diameter and 5ft. 6in. stroke. These cylinders stand each one under its own beam, and between them is placed the intermediate receiver or hot-pot, a cylinder about as large as the low-pressure cylinder. The engines work cranks at right angles at the ends of the fly-wheel shafts, and the plunger pumps are worked direct from the beams with a stroke of 4ft. The exhaust steam from the high-pressure cylinder has to pass through a thin annular space with full-pressure steam from the boiler on both sides of it in the hot-pot, and by this means the steam condensed in the high-pressure cylinder is re-evaporated, and dry steam only is delivered to the low-pressure cylinder. We have on more than one occasion dwelt on the importance of using dry steam in the large cylinders of compound engines. Mr. Cowper's figures confirm the accuracy of our conclusion; they also support our often-reiterated assertion that high pressures are not essential to economy, the boiler pressure at Ditton being only about 75 lb. absolute. The conditions of the trial were such that it is very difficult to see how any error could have crept in; yet the engines used but 13·39 lb. of feed-water per indicated horse-power per hour. To this must be added the steam condensed in the jackets and hot-pot. This was not measured, but amounted, according to Messrs. Simpson, to a little over 2 lb. per horse per hour, thus bringing the total consumption up to, say, 15·5 lb. The best results we can compare these figures with are those got from a Saltaire engine mentioned by Mr. Clark, which required 17·4 lb. of steam. It has also been stated that some pumping engines in the United States, constructed by Mr. Leavitt, get on with 16 lb., but of this we have no trustworthy proof. Mr. Clark gives the best result for compound engines as about 18lb. There are compound engines which have perhaps slightly beaten the Saltaire engine, but we think we shall not be wide of the mark if we say that no quite trustworthy record has ever before been published of a performance in which the engine used less than 17 lb. of water per indicated horse-power per hour. When it is borne in mind how difficult it is to save a pound of feed-water when an engine is already very economical, it will be seen that the performance of the Ditton engines is really phenomenal.

It appears from the diagrams that steam was cut off in the small cylinder at about one-eighth of the stroke. The clearance is, we know, very small. The high-pressure piston has an area of 346·36in.; the stroke is 66in., and one-eighth of this is 8·25 in.; allowing half an inch, as equivalent to clearance in ports, passages, and cylinder, we have 346·36 × 8·75 = 3030·66 cubic inches of 75 lb. steam per stroke, or per minute, 133,349in. = 77·17 cubic feet per minute, and per hour 4630 cubic feet, weighing 814·4 lb. Assuming a fifteen-fold expansion, 75 lb. initial pressure and 1·5 lb. back pressure, the calculated power of each engine, on the assumption that the curve of expansion was hyperbolic, would be 127 indicated horses, proving that the curves were very nearly hyperbolic. It was actually 120-horse power in round numbers. The consumption of steam by the indicator, which takes no account of condensation, was but 6·616 lb. per indicated horse-power. Such a result is absolutely unprecedented. It will be seen that our figures are based on the point of cut-off, as shown by the indicator. In other words, on the cubic space filled at the beginning of each stroke with steam, and not on the nominal cut-off. We have before us a table of some of the finest results ever got from steam engines; picking out the best of these, we find a Corliss engine using 10·63 lb. per horse per hour by the indicator; a 72in. engine at the East London Waterworks requires 13·58 lb.; the low-pressure cylinder of a pair of compounds by Messrs. Day, Summers, and Co., used 11·99 lb.; the high-pressure cylinder of a compound engine by Messrs. Donkin requires 10·09 lb. If we compare even this last figure with the performance of the Ditton engines, it will be seen that the difference is enormous—not less than nearly 3·5 lb. of steam per horse per hour. The ratio which the steam, as measured by the indicator, bears to that actually used, was in the case of the Donkin engine 100 to 203; that is to say, 103 per cent. more steam was used than the indicator accounted for. In the Ditton engines the steam actually used was a little more than 134 per cent. in excess of that accounted for by the indicator. We may say again that this result is unparalleled by the performance of any good engine with which we are acquainted; and it proves that, in spite of the use of every expedient known to science, the condensation of steam in an engine must be very great. It may be urged that the 8·884 lb. of steam condensed per horse per hour in the cylinders, jackets, and hot-pot was condensed in the performance of work; but this cannot be the case, as assuming the initial cylinder pressure to have been 75 lb. absolute—and this is not far from the truth—and the terminal temperature of the steam 107 deg., the condensation of about 2·3 lb. of steam would have sufficed to liberate heat, the equivalent of 1-horse power for an hour. Accordingly, we have a condensation of 6·584 lb. per horse per hour to be explained. This was due, of course, to the usual causes, namely, the inability of the jackets to prevent condensation from taking place in a cylinder exposed to considerable alterations in temperature. Putting on one side the question of relative performance, it is a curious fact that this is absolutely a very much larger condensation than takes place in engines in which no reheating device is employed. For instance, the Saltaire engine to which we have already referred only uses 20 per cent. more steam than is accounted for by the indicator. Its actual consumption is 17·4 lb. of steam per horse per hour, and 20 per cent. of this is 3·48 lb., as the quantity condensed per horse per hour. Other instances might be cited if it were necessary. In order, however, to draw a proper comparison of this kind it is essential that the steam be worked under the same conditions of expansion and pressure in the cases compared. The advantage of the hot-pot lies not in reducing the positive loss of steam by condensation in the cylinder, but in reducing the loss, as compared with the grade of expansion. For example, it has hitherto been found impossible to expand steam anything like fifteen-fold without bringing about an enormous condensation. Thus, in an engine which we tested some years ago steam of 80 lb. absolute pressure was expanded fifteen times. The quantity used was 22 lb. per horse per hour. Assuming that it was as efficient in this engine as in the Ditton engines, then the indicator would have accounted for 6·616 lb. only, and the difference, 15·384 lb., would have been condensed.

The greater the range of expansion the less will be the quantity of steam accounted for by the indicator, and the greater the quantity, other things being equal, condensed in the cylinders. For some reason not fully understood, a very small quantity of water in a cylinder enormously augments the condensation. The hot-pot seems to play the part of a drier very effectually. It can do nothing whatever to help the high-pressure cylinder, but it no doubt augments the power given off by the low-pressure cylinder, by keeping up the expansion curve in that cylinder; and this seems to be entirely a result of drying the steam, and not of heating it. Indeed, the temperature of the steam as it enters the low-pressure cylinder at Ditton is, we are informed, not more than 5 deg. or 6 deg. higher than that of the same steam before it passed through the hot-pot. If our readers will turn to the account of the performance of a compound engine by Messrs. Richard Garrett and Son, which appeared in our impression for 26th November, 1880—the only compound portable engine which we have as yet had an opportunity of personally testing—it will be seen that a very high duty was got from it. All through the engine is non-condensing; it required but 22·8 lb. of steam per horse per hour, and the high efficiency of the steam was, we believe, mainly due to the circumstance that the pressure in the intermediate receiver was raised high enough to re-evaporate nearly all the water condensed in the high-pressure cylinder; consequently the large cylinder was supplied with dry, or nearly dry, steam. The drawback to this method is, that the power developed in the two cylinders is very different, the greatest power being got from the low-pressure cylinder. But this is not an insurmountable objection, and the system is very simple, and easily applied in practice.

It will perhaps not have escaped notice that the boilers at Ditton were abnormally economical, and this although, as Mr. Cowper tells us, the furnaces were not quite what he would have liked them to be. It will be seen that these boilers had to evaporate 15·5 lb. of water from an average temperature of probably 92 deg. with 1·6 lb. of coal. This is within a small fraction of 9·7 lb. of water per lb. of coal, equivalent to an evaporation of 10·86 lb. at 212 deg. We have no hesitation in saying that this again is an unparalleled result. Nothing at all approaching it has ever before been recorded of a plain Cornish boiler. We have found 9·5 lb. of water per pound of coal the highest duty that could be got from two large Lancashire boilers, 30ft. long, with Bwlfa coal, which is as good as Nixon's navigation. The grates were specially adapted for burning this coal, and the bridges had been altered to get the best possible result; in addition the feed-water was heated to 120 deg. Our readers will, we think, join with us in saying that it is desirable that Mr. Cowper should express his views concerning the performance of the Ditton engines and boilers more fully than he has done in his meagre report. We have, as we have said, an almost, if not altogether, unparalleled performance of steam machinery to deal with, and engineers will expect some explanation from the man who has secured so wonderful a result.

TELEPHONE WIRES OVER THOROUGHFARES.

Mr. John Walsh, telegraphic engineer, Stretford, near Manchester, has presented a report to the corporation detailing the results of his examination of the several lines of over-house telegraph and telephone wires in the borough. With the Postmaster-General, he does not apprehend the corporation will have any difficulty, but with all over-house wires one or two conditions should be insisted on. Chief among these are—(1) All over-house wires crossing streets or parallel to streets where there are approaches to works, &c., should not be less at the lowest point than 35ft. from the ground, so as to allow a sufficient headway for the fire-escape; (2) over wires should cross streets at right angles, and be "shackled off" at both sides of the street; (3) over-house wires should be placed upon poles where possible and not on buildings. Mr. Walsh specially compliments Messrs. Tasker, Sons, and Co.'s construction of their telephone and private telegraph wires, and mentions that no better test of their strength could be obtained than the fact that they stood the severe storms of October and November without injury. Their manager, Mr. Johnson, was an efficient telegraph engineer, and would no doubt continue to keep Messrs. Tasker's telephone wires in a good state of repair and condition. What Mr. Walsh, indeed, practically recommends, is that the principles and regulations laid down with respect to Messrs. Tasker's wires should be strictly enforced with all other owners of private telegraph or telephone wires in Sheffield, and no new lines of wires should be allowed to be erected without the sanction and approval of the corporation being first sought for and obtained.

PROPOSED TUNNEL UNDER THE THAMES.

Some of the local authorities in the east end of London are much exercised at a rumour that the Metropolitan Board of Works have a project under consideration for a tunnel from the Whitechapel-road to the south side of the Thames, this being, in their opinion, the best method of satisfying the great need of communication. It would probably be more correct to say that the tunnel is proposed in order to avoid the opposition of the City authorities, who, apparently, will consent to nothing—however much for the good of the metropolis—which may touch the vested interests of Billingsgate and Thames-street. At any rate in the East of London, beyond the City, the need is for the bridge, and not for a tunnel, and this view is to find expression at the next meeting of the Whitechapel District Board of Works on Monday, the 19th inst., when Mr. William Smither, the well-known carrier and local representative, is to move:—"That in the opinion of this board the proposed means of communication between the north and south side of the Thames below London Bridge should be a low-level bridge." If London had a representative government like every other town and city in the empire, a resolution such as this would have had effect long ago.

THE DESTROYER.

Further information has reached this country concerning Ericsson's torpedo boat, the Destroyer. It appears that he has abandoned the use of steam for ejecting his torpedo from the boat, and uses gunpowder instead. Thus the boat really carries a submarine breech-loading gun. The target referred to in The Engineer, for November 18th, was made of manila rope and wooden slats. A dummy projectile, or one of wood only, was discharged from the gun. The muzzle of the gun was 6½ft. below the surface of the water. The charge was 12lb. of giant powder. The projectile was 25½ft. long. The gun is aimed and discharged by electricity, operated by the steersman. The projectile traversed the target at a depth of 5ft. beneath the surface of the water, appeared on the surface about 100ft. beyond, and continued its course with considerable velocity for 200ft. more. A submarine distance of 400ft. was made in three seconds, although the gun charge was, as we have said, but 12 lb.

AMERICAN LOCOMOTIVES IN ENGLAND.

ENGLISH engineers will be somewhat surprised to learn that the order has been obtained in this country for a considerable number of American locomotives for railways in America. They are now being built from the designs and instructions of Mr. James Cleminson, M.I.C.E., Westminster, by a leading North of England firm, and are on the true American type, as represented in Baldwin's "America," "Mogul," and "Consolidation" classes, though some slight modifications are made in the arrangement of the compensating beams. The system of compensation is carried out completely so that the wheels must bear with full weight on any road, just as the speculum of a large telescope is supported on Lord Rosse's or Grubb's system of connected levers. It is expected that the engines will show what can really be done by locomotives on the American type built on the best English methods and workmanship, and we shall probably learn how much truth there is in the oft-repeated statement that American locomotives will haul a greater load, weight for weight and cylinder for cylinder, than those of the English type.

LITERATURE.

Elementary Treatise on Natural Philosophy. By A. PRIVAT DESCHANEL. Translated and edited by J. D. EVERETT, M.A., F.R.S. London: Blackie and Son. 1882. Sixth edition.

WHEN a book has reached its sixth edition, it is almost of necessity so well known, that of a new edition it is only necessary to speak of the additions and modifications made in it. It is difficult to understand why the date 1882 should be put on the title page, unless it is because the remarkably rapid strides being made in the applications of electricity have made several additions necessary to the part dealing with electricity, which was published earlier this year; while to hold back the volume now before us would have made it somewhat behind the time on this subject. The book is published either in one volume or in four parts, and while referring to the electrical part, we may at once mention as an illustration of the rapidity with which books on current electricity become behind the time, that, though a description of the Planté secondary battery is given in the new edition, the Faure battery is not described, nor is the Planté illustrated, nor the Varley battery mentioned, subjects which are engaging as much as any in the electrical world just now. In other respects, however, great additions are made to the electrical chapters, and the descriptions of the methods of testing by Wheatstone's bridge or Christie's, as perhaps it should be called, are amongst the useful new matter. One of the new forms of dynamo-electric machines is described, but as a student's book, a diagram illustration of these machines as used by Professor Adams in his Cantor lectures would have been a most useful addition, as showing how the magnets are wound and placed in connection with the armature, commutator, and shunt, and also how Wheatstone's observation that the effects are increased by diverting a great portion of the current from the magnets by means of a shunt; and subsequently how the work, as a lamp, was placed in the shunt are carried out. There seems to be some error in the description of the device by which Planté was enabled to alter the connections of a large number of his batteries instantaneously, so as to be in series as soon as the charging is completed, as this is called a rheostatic machine. As the device is not illustrated this is rather confounding.

Turning back to the commencement, we find considerable alterations and additions in the chapters dealing with heat and thermo-dynamics. The Centigrade scale is used throughout the book, and this is to be commended; but most English readers will be glad to find that though the centimetre-gramme-second or C.G.S. system is described, we are spared at present the infliction of a book using that system throughout; and for this we ought to be thankful, when we remember the temptation that Professor Everett, who is the author of the book on "Units and Physical Constants," in which this system is developed, must have experienced in revising this edition, unless in his book he had enough of it.

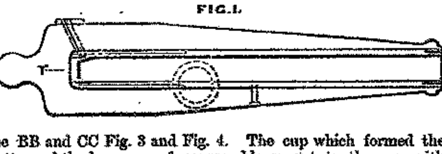
In the chapter on steam and other heat engines we find little change, and here change and addition might have been very necessarily made. Stirling's air engine is described and illustrated, but we have nothing more modern, though the Rider engine is very largely in use, and Stirling engines are obsolete. The illustrations and diagrams of steam engines are old when they might as well show modern practice, and give students modern ideas at once, instead of making it necessary for them to unlearn ideas that they will gather from these old pipey, long-ported, and many parted engines. Of the locomotive a much more modern and accurate section might just as well have been given, and of the modern gas engine something more than perspective views should have been considered necessary by the author to supply the information which students require. Of the compound engine, too, something more than a pair of contiguous cylinders connected by a pair of cross pipes could have been just as easily illustrated, and would have enabled students to obtain a practical idea of a compound engine at once, instead of a perhaps half-formed conception of a mixture of two cylinders by plumber's aid. The steam engine may "be on its last legs," but we imagine that its last legs will probably last as long as its first, and therefore the steam engine might be illustrated as made now rather than as made when Professor Everett was very much younger.

We have thus found fault with the book where necessary, but nobody needs to be told that Professor Everett's "Deschanel's Natural Philosophy" is amongst the best and most clearly written books dealing with most of its many and interesting subjects.

BURSTING OF A SPANISH CONVERTED GUN.

THE *Revista General de Marina* for October gives a short account of the bursting of a Spanish cast iron gun lined with wrought iron coils while firing with shell. The piece was originally a smooth bore of 20 centimetres, lined and rifled, being then brought to 16 centimetres (6·3in.) calibre. The firing charge was the service one of 6 kilogrammes (13·2 lb.). The gun appears to have yielded by blowing out the breech end, which flew to the rear. Figs. 2 and 3 show that it yielded in a line from the bottom of the bore to the curve or exterior angle of the metal, on rear of the vent and vent field. The piece also split longitudinally in a vertical line as cast iron pieces generally do,

FIG. 1.

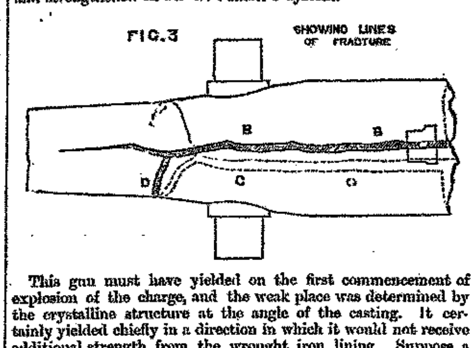


see BB and CC Fig. 3 and Fig. 4. The cup which formed the bottom of the bore was, of course, blown out to the rear with the breech, the coils into which it was screwed being unwound, as shown in Fig. 2 and Fig. 4. The coils do not appear to have been rent, they seem to have held well together, *vide* Fig. 4. The writer of the Spanish report considered that the longitudinal work was equally divided between the projectile and portion of

FIG. 2.

the breech blown out, because there was little or no recoil. Happily, no very serious injury was done to the detachment. This result doubtless interests Spain very directly, if this gun is a representative of a large class; the question is, how far does it concern us in England? Increase in length and the introduction of breech loading tend to limit the sphere of conversion as applied to our service cast iron guns. Nevertheless the question is an important one if, as we believe, about 50,000 rounds are annually fired from cast iron pieces converted into rifled guns, and strengthened on Sir W. Palliser's system.

FIG. 3 SHOWING LINES OF FRACTURE



This gun must have yielded on the first commencement of explosion of the charge, and the weak place was determined by the crystalline structure at the angle of the casting. It certainly yielded chiefly in a direction in which it would not receive additional strength from the wrought iron lining. Suppose a casting to be bad and inclined to yield longitudinally, it is evident that the lining cannot help it to hold together. It may, however, be urged that this constitutes an objection against the conversion of cast iron ordnance. This appears to hold good to this extent, namely, that the longitudinal strength of a cast iron piece fixes the limit of work that must be attempted to be

FIG. 4.

obtained from it by conversion. It is, however, extremely uncommon for a gun to yield in this way. Generally a gun has a sufficient margin of longitudinal strength to admit of a considerable gain to be obtained by conversion. The coils appear to have behaved very well. It is difficult to say what strain was thrown upon the piece. The charge 13·2 lb. is rather large; 12 lb. R.L.G. is the largest charge we fire from our 64-pounder 6·3in. wrought iron gun. The nature of the Spanish powder, however, is not stated. In this case the weight and velocity of the projectile would tell us more than anything else. We should be inclined to think that the cause of rupture was simply a fault in the cast iron. One thing appears certain, that the wrought iron prevented the whole gun from flying into fragments, and thus, perhaps, it saved the lives of the detachment. We hold that the Palliser system of conversion is good, and we would point out that in this country, as far as we know, no accident of any kind has occurred with it.

PUMPING ENGINES, CANTERBURY SEWAGE WORKS.

WE illustrate at page 437 pumping machinery recently constructed by Messrs. Gwynne and Co., of Essex-street, London, for the Canterbury Sewage Works. The price paid for the land at Sturry was £3500, and the cost of building the work, three cottages, draining and preparing land, boilers, engines, pipes, and all complete was £4800, making a total sum of £8300. The sewage farm covers 22½ acres of land, lying to the east of Sturry-road. At the present time eleven acres are devoted to the cultivation of mangold wurtzel, which are estimated to return forty tons per acre.

The Broad Oak Sewage Works will be utilised as heretofore in conjunction with the new works. The whole of the sewage matter from the city will be conveyed to the old works in the first instance; the solid matter will be separated from the liquid, which after filtration will run to the new works for irrigation purposes as described below. It is confidently believed that these will be the most perfect works in England carrying out the process of sewage irrigation. In all other instances the raw sewage is placed upon the land for natural filtration, here the solid matter is retained at the Broad Oak Works, the effluent water alone being spread over the land.

In the engine house there are two pumping engines of 15-horse power, each capable of discharging 1400 gallons per minute to a height of 35ft., but the engines can if necessary be worked up to 25 or 30-horse power, when they would each discharge 2600 gallons per minute. The boilers are each 5ft. 8in. in diameter, by 18ft. long, with one internal flue 3ft. in diameter and six Galloway tubes. They were tested up to 125 lb. to the square inch, the pressure remaining for half an hour. There are two donkey pumps for the supply of water to the boilers, and one air pump for charging the centrifugal pumps. The engines work very satisfactorily, being so powerful that the sewage water can be carried to within a short distance of the height of the table land at Scotland Hills. They can be worked together if necessary without any difficulty, and either will discharge 1400 gallons per minute. An admirable supply of water is obtained from a surface well at the depth of 10ft. at a short distance from the engine-house. The water proceeds from a bed of gravel, and answers the purpose for which it is required perfectly. At the pumping station there are two cottages and sheds. As the sewage water enters the well from the old works, it is pumped up and delivered through five lengths of 18in., 15in., and 12in. covered stoneware carrier pipes, extending the length of land. The sewage in its passage along the carriers is stopped by sluices in the distributing wells, which are placed at distances of about 200ft. apart. The water rises in these until it reaches the surface of the land, when it passes through sluices which are made to regulate the flow of water, so that either a small or large quantity can be put on any particular piece of land. The buildings have been erected by Mr. John Bingham, of Headcorn, from the designs and under the personal supervision of the surveyor, Mr. J. G. Hall, Assoc. M. Inst. C.E.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty: Chief engineer James McGough to the Monarch, *vice* Holloway, the appointment of chief engineer Thos. J. Gissing being cancelled; engineer George H. Cooke to the Asia, additional, for service in the Cyclops, *vice* Laird; Frederick H. Herrmann, chief engineer, to the Euryalus, recommissioned; Thomas Hughes and Joseph Langmaid, engineers, to the Euryalus, additional; Charles F. H. Tilbrooke, assistant engineer, to the Euryalus, additional; and John W. Agnew, assistant engineer, to the Assistance, *vice* Langmaid; Herbert Wooley, chief engineer, to the Asia, additional, for service in the Minotaur, to date from the 24th inst.; and George Brewer, engineer, to the Asia, additional, for service in the Minotaur, to date from the 24th inst.

NEW DIARIES.—The advent of packages of diaries, always welcome in itself, reminds us of the near departure of the year. Messrs. Letts' collection, both for number and variety, is specially noticeable. Every need has been supplied; every whim, one may say, has been humoured; every size produced, and every pocket considered. The general information contained in the larger diaries is immense. There are also Housekeeping Expense books, already well known, and Family Registers, both of which will be in request. Our contemporary, the *Chemist and Druggist*, has also issued a diary, and a very copious one it is. As far as one outside the pale can judge of information of so technical a character, we should say that it is of great value to the class for whom it is specially produced. The advertisements, enough of them to make one's journalistic mouth water, are in their way scarcely less interesting than the matter. The "City Diary," published at the office of the *City Press*, is a useful six days in a page and cheap diary, as is also for some purposes Blackwood's shilling interleaved scribbling diary, foolscap size. A diary calling for special notice in our columns is the Railway Diary and Officials' Guide. As the title indicates, this diary contains a great deal of information on the railways of the kingdom, and their officers. It gives the miles open, and in most cases the date of opening, and might usefully give the gauge of the lines. It is a cheap and useful diary. With this diary is also a sheet railway almanack.

ANNUAL DINNER OF THE SOCIETY OF ENGINEERS.—On Wednesday evening the annual dinner of this Society was held at the Guildhall Tavern, Gresham-street, and was attended by nearly 100 members and friends. The chair was occupied by Mr. Charles Horsley, C.E., F.G.S. In proposing the toast of the evening, "Success to the Society," the chairman said that the Society was nearly twenty-eight years old, that it was doing a great deal of good work, and that it would do much more if members availed themselves more of the opportunities of inspection which were afforded by the visits which the members were privileged to make, and if they would state more freely at the ordinary meetings the reflections which had been suggested to them by what they saw and heard on the occasions of those visits. They had been permitted to visit, among other places, the Mint, the Royal Dockyard at Sheerness, the fortifications there, and the works of the Great Eastern Railway, and all concerned did everything in their power to make the visits as profitable to the members as possible. The subjects that had been discussed at the Society's meetings had embraced gas engines, dock gates, the prevention of smoke, iron roofs, and the machinery of breweries. An addition of 31 members had brought the total up to 400. They were always well received wherever they went, and the advantages of the Society's work were highly appreciated by the members, but not so much by those who relied upon their transactions as by those who availed themselves personally of the privileges of members. The prospects of the profession were improving; they did not do much last year, but there was every prospect now that they were going to have a first-rate time of it. Mr. A. Williams, hon. secretary and treasurer, and one of the founders of the Society, said that the excursions and visits were the most useful part of the Society's work, for it was one thing to be able to make a drawing and another to be able to give those further instructions which could not be given without the knowledge and experience that could be derived only from observation. Mr. Jabez Church, president-elect, said there were a good many Bills to come before Parliament next session, which was a good sign for the profession. There was a vast amount of work for engineers to do in this country; so far from being "played out," as some said, he believed they had more to do than they had ever done before. Science was making advances, and engineers had to adapt themselves to the changes which must follow. The toasts included the Vice-Presidents, the Council, and the Secretary (Mr. B. Reed), who was complimented on his arrangements for the excursions, and a good selection of vocal music was given under the direction of Mr. Montem Smith, by Mr. H. Aston, Mr. G. T. Carter, and Mr. Chaplin Henry. Mr. A. Williams, Mr. Jabez Church, Mr. Isaacs, Mr. R. P. Spice, Mr. T. Porter, Mr. R. Berridge, Mr. S. Cutler, and Mr. C. Gandon responded to other toasts.