

ELECTRICAL ENGINEERING IN SWITZERLAND.

There seems a general consensus of opinion that the late tour of the Electrical Engineers in Switzerland was very interesting and instructive, besides being enjoyable. The lessons which may be learnt from it seem to divide themselves into two heads:—It is possible to deal either with the technical aspects of Swiss work, or with the broader principles which underlie the great development of electrical enterprise which, has taken place there, and which shows no signs of halting, but rather of proceeding at an accelerated pace.

The readers of THE ENGINEER being chiefly concerned in general engineering questions, it is proposed to leave the more technical aspect of the subject to the electrical papers, which are dealing with the matter very fully, and to confine what follows chiefly to more general considerations. In estimating the electrical work which has been done in Switzerland, it is desirable to recollect that Switzerland is a small country in itself, the whole population of which is hardly more than two-thirds that of London alone, though, of course, it is exceptionally favoured by the number of people who are attracted there during a few months in the year.

The energy and enterprise with which the Swiss have entered into electrical work, and the way they have utilised electrical methods for their convenience and profit, is a matter deserving of the most careful study, because what they have done in a small way and within the bounds of their own country is undoubtedly an epitome of what will be done within the next twenty years, to an even greater extent, in all enterprising parts of the world. At the same time, while meting out their full share of praise to Swiss engineers, it is only fair to say that local circumstances have in many ways been extraordinarily favourable for the development which has taken place.

The general price of coal in Switzerland to manufacturers situated close to railways is about £1 per ton, and the coal is not very good, according to English notions, even at this price. On the other hand, there is an enormous amount of water power in different parts of the country running to waste; and moreover, owing to much of this power being fed by mountain streams taking their rise in glaciers, the flow is much more constant than is usually the case under ordinary circumstances. Again, nearly all the gradients of the streams are very steep, which is, too, an important condition. The necessary hydraulic works can be usually constructed at a moderate comparative cost, and the flow of the stream is only interfered with for a short distance, so that the normal flow is not much altered, nor are the rights of owners of property or other water powers above or below prejudiced. Thus a number of serious local and practical questions which nearly always arise the moment one attempts to do anything with water power in England, or over, at any rate, a considerable portion of the globe, are almost non-existent in Switzerland, consequently the Swiss have not only the advantage of water power itself, but it exists under circumstances which make it easy to utilise. Again, from periods long anterior to the date when electrical transmission became possible, the Swiss were already noted as specialists in hydraulic work and the building of turbines, much water power having been utilised there by means of rope transmission and in other ways, consequently there were plenty of enterprising people ready to suggest opportunities the moment the coupling of a dynamo to a turbine was shown to be practicable. The earlier electric-power transmissions in Switzerland were founded on the use of continuous currents, and Colonel Thury, of the Société d'Industrie Electrique of Geneva, has developed an extremely interesting system in which motors are coupled in series, by which means it is possible with proper arrangements, to work with line pressures up to 5000 volts, and even higher, and thus transmission can be effected over long distances. Quite a number of these installations have been erected and are satisfactorily working. At the same time, since Colonel Thury devised this system, there has been immense developments in the use of polyphase alternating currents for power transmission, and there can be no doubt that under most circumstances in flexibility, convenience of handling, cost and certainty, this method is superior to a continuous-current system.

No sooner were the ideas of the late Professor Ferraris, of Milan, on polyphase motors made known, and the patent specification of Nikola Tesla published, than they were speedily taken up by Mr. C. E. L. Brown, who was then the electrician of the Oerlikon Company, of Zurich. Experiment quickly demonstrated that, in a number of ways, these motors were just the thing that was required, both for the generation and utilisation of electricity for power transmission; and the Oerlikon firm quickly began to put up installations on this system, which soon attained a great notoriety through the installation which was put up at the Frankfurt Exhibition of 1891, when, by the joint enterprise of the Oerlikon Company, the Allgemeine Electricitäts Gesellschaft—a large German company—and the German Government, some 300-horse power were transmitted a distance of 112 miles with a comparatively small percentage loss. Not long after this, Mr. Brown, not being satisfied to continue as one of the staff of the Oerlikon Company, retired, and shortly after established works in connection with his present partner, Mr. Boveri, which have been exceedingly successful, and which undoubtedly continue to take the lead of all works on the Continent in the design and construction of electric plant based on the polyphase system. These works were inspected by the Electrical Engineers, and now employ about 1300 hands. Being quite new, they have been designed in accordance with the most modern ideas, and are replete with all the latest tools which can be procured in England, America, and on the Continent, for carrying out work of this character up to very large sizes.

It may be worth while saying a few words more about

Mr. C. E. L. Brown and his family, as they have impressed themselves very strongly upon Swiss engineering; in fact, one might almost say upon the engineering of the world. Mr. Brown's father, who is still alive, is an Englishman, who, like many others drifted to the Continent in the great railway-making days, when, private enterprise not being hampered as it is now, Englishmen having got the lead in building railways, not only built their own, but did a huge amount of work in building them for other people on the Continent and in other parts of the world.

Mr. Brown, we believe, married a German lady, and ultimately became connected with the celebrated firm of Sulzer Brothers, of Winterthur, the well-known engine builders, and had a long and honourable connection with them, assisting largely in building up their specialities.

Two nephews of Mr. Brown, sen., are now intimately connected with the management of Messrs. Sulzer's works and the locomotive works which adjoin them, while Mr. C. E. L. Brown, the son of Mr. Brown, sen., together with a younger brother, who has also great engineering talents, are the moving spirits in the firm of Brown, Boveri, and Co., which has already been mentioned. English blood has therefore had a considerable share in the development of the men who now stand at the head of Swiss enterprise.

It may surprise a good many English people to learn that in some ways the conditions of labour in Switzerland are as strict or even stricter than they are here, although the working hours are longer. In engineering shops these appear to be about 60½ hours per week, at least these were the hours of the men in Messrs. Sulzer's employ, or about 20 per cent. longer than English hours. An Englishman who had been some years in Switzerland told us that he thought the rate of working was about 20 per cent. slower than in England, while the rate of wages for skilled men is some 20 per cent. less, so that, counting the extra hours worked, the rate of pay received by the men per week is not very different from that current in England for similar work, and the output per man is roughly about the same. Everyone was struck with the cleanliness and intelligent look of the men, and their neatness, all wearing blue overalls.

The rules are very strict about overtime, and not a single man can work even an hour or two after hours to finish a job without first obtaining leave from the Government Inspector, and no permission obtained in this way is current for more than six weeks, unless a further application is made and passed. Partly on account of these restrictions, Messrs. Sulzer keep a factory in Germany, where a great deal more latitude is allowed, and where they can undertake and carry out work which would be difficult under Swiss conditions. The working hours are also somewhat different from ours.

Not only the coal, but the steel and iron used come from Germany or France, and some from England—which, of course, must be a heavy handicap in work for export. Swiss engineers, however, are fortunate in being able to secure a considerable amount of trade in countries bordering on their own—particularly Italy, to which a great deal of plant has gone for electrical work of one sort and another.

Although the electrical engineers devoted nearly all their time to the inspection of electric power and tramway plant, no account is complete of the manner in which the Swiss have availed themselves of the facilities which the employment of electric transmission gives, without reference both to electric lighting and use of the telephone.

In England the Government took the course of imposing a tax of 10 per cent. on the gross receipts of all telephones, and as the gross receipts are half the net receipts after paying for working expenses and depreciation, this is a tax of 20 per cent. on the cost of telephone communication, and is thus a very heavy impost on a trade facility of the highest importance. The development of the telephone has also been greatly hindered by the English Government first adopting a policy of encouraging competition, then, after a great deal of vacillation, changing the policy to one repressing competition, and again now, after much agitation, changing back again to the policy of encouraging competition by municipalities. As the Government have never had the courage to go into telephone work themselves properly, and, on the other hand, have been too timid and fearful to grant the facilities and security which would have enabled the work to be done properly by private enterprise, the result is that in the use of the telephone England is far behind a number of other countries. We are not speaking now so particularly of the great towns as of the smaller ones and the country districts. Although the telephone is exceedingly valuable in towns, yet, when the distances are short, there are obviously a number of other methods of communication. But the real value of the telephone, we have always held, lies in the power it gives of placing the smaller towns and villages, and even country residences, in close touch with the nearest towns and the country generally. There is something almost comical in the stupidity which has not only failed to give facilities, but has actually put obstacles in the way of carrying out work of this character, although the flocking of people to towns has been a matter of national anxiety, while one of the best means of keeping people in the country is to give them as nearly as possible the same facilities of communication as are enjoyed by towns.

In America this facility of communication, with all its corresponding advantages, has been provided entirely by private enterprise. In Switzerland the same result has been achieved by the Government. By which means the public in these countries have been able to obtain these advantages at the lowest expense it would be hard to say, as the circumstances are so very different.

From the first the Swiss Government have adopted the enlightened policy of endeavouring to give all the advantages which could be derived from the use of the telephone at as low a cost as would cover interest on capital employed.

Believing, like the other nations of the world except ourselves, that the facilities given by electric communication far outweighed any sentimental reasons, overhead wires have been freely permitted everywhere. The consequence is that not only is the telephone used extensively in all the towns, but can also be found in quite small shops in country villages, the advantages of which in a mountainous country it is often difficult to estimate.

In the same way in many districts the electric light will be found with all its conveniences, even in the cottages of workmen in out-of-the-way villages, this latter being usually supplied by power supplied by some neighbouring waterfall.

Coming now to the more immediate objects of the Electrical Engineers' tour, namely, the inspection of electric power, tramway and railway plant. The manner in which electricity has been utilised for each of these purposes is worthy of the most careful study. Take, for instance, the power station at Rheinfelden, a few miles from Basle. The Rhine here runs down a rapidly-descending slope for some two or three miles. Advantage has been taken of this to run a strong retaining wall about, say, half a mile up the stream at some distance from the bank, in itself an undertaking of considerable magnitude. By this means a backwater has been created so that, at the lower end at the power station the level of the water is about 14ft. above that of the river which passes it. A long power house has been erected at this point to receive twenty-two turbines, each of about 1000-horse power, which discharge their water directly back into the river. When we were there last year there were about five turbines erected and working, but the demand for power has so greatly increased since, that on the occasion of the Electrical Engineers' visit this year, nearly the whole number was installed and working, and it was in contemplation to make other large extensions. In considering this project it must be recollected that it is four or five years since it first took shape, and since German capitalists had the confidence to embark at least a quarter of a million to start with on this enterprise, whereas English financiers seem to be just beginning to have a glimmering of a notion that there is likely at some date in the future to be an opening in this direction. The power from the station is largely used on the spot for chemical work, and for the manufacture of aluminium. The remainder of the power is distributed by overhead wires to a number of factories within a range of some miles, and the current is being carried to surrounding villages for lighting and power purposes to distances of ten to fifteen miles. In fact, there is no doubt that the nucleus of a great industrial centre is being rapidly formed. Another interesting power house of this character was seen by the Electrical Engineers at Kander, near Thun. In this case the installation is smaller, representing about 5000-horse power, but it is even more interesting from the fact that the pressure of the current is raised to 16,000 volts. Part of the current is transmitted to Berne, a distance of about 30 miles, where it is utilised for the lighting of the town and supply of power. The remainder of the current goes to supply the Thun-Burgdorf Railway, which, again, was one of the most interesting things, if not the most interesting thing, seen in Switzerland by the Electrical Engineers. This railway, which is about 30 miles long, and the end of which must be some 40 miles distant from the power station, is worked by three-phase currents transmitted from it. The railway is of the ordinary gauge—in fact, forms part of the general system of the country—and ordinary locomotives can run over it. It is, however, regularly worked by electric locomotives of about 240-horse power each, and which are arranged to run at approximate speeds of 18 or 35 miles per hour. The working of the line, although admittedly still in an experimental stage, appeared thoroughly satisfactory, and it will undoubtedly be the pioneer of great developments in this direction.

Next in interest to this railway come the rack-railways. These rack-railways effectively dispel the idea which has been very prevalent in England, but which has no foundation whatever in fact, that multiphase motors have only a small starting torque. The sight of a train full of passengers starting from rest with ease up an incline of 1 in 5 or 1 in 4 is sufficient to dispel any such notions; and again, the back electromotive force of the motor is used as a brake coming downhill, and it is an extraordinary practical illustration of the transfer of energy across what appears to the ordinary eye nothing but air, when the whole of the power required either to take such a train upwards, or to prevent it running too quickly downwards, passes through the gap between the armature and the field magnet. The ordinary brakes with which the trains are, of course, provided, are only used in case of emergency. A very pretty point comes in here, however. If the train were running downhill, and the back electromotive force of the motors approached or exceeded that of the generator, the load would be largely taken off the generator, and it would tend to run away. In order to prevent this, a working load is provided by means of a water resistance placed across the circuit, in which sufficient energy is expended to maintain a load on the generators.

In ordinary tramways the Swiss are well to the front, but these call for no special comment, except the power station of one of the tramways at Zurich, which is and has been for some time successfully worked by means of gas engines driven by Dowson gas, assisted by a battery of accumulators to relieve the engines of the heavy sudden starting loads.

No account of the Electrical Engineers' tour would be complete without a reference to the superb Polytechnic, or, rather, one should say, Technical University of Zurich. English manufacturers and engineers who have not made education a special study can have no conception of the energy and money which has been expended in developing this great institution, the electrical laboratory of which alone with its equipment has cost £50,000, and the mechanical workshops considerably

more. With such an institution at their back much more in touch with manufacturers, there is reason to believe, than is the case of technical institutions in England, it is no wonder that a constant and large stream of men is continually being turned out equipped for tackling to the best advantage a multiplicity of problems which the continual advance of science is with increasing rapidity bringing within the scope of practicability.

In conclusion, it should be mentioned that the tour of the Electrical Engineers will probably be memorable, not only on account of what those who took part in it saw of the engineering work in Switzerland, but also for what they saw of each other. There have been electrical congresses which, however, have largely been attended by professors, and, of course, there have been meetings of municipal engineers. But this is practically the first occasion on which a large, general, and representative body of members have been brought together under friendly and social conditions for several days together, and there is little doubt that the friendships and intimacies formed, and the interchange of ideas which took place under freer conditions than is possible in the ordinary conduct of business, will not be the least fruitful of the results of this memorable and successful tour.

BRITISH AND AMERICAN MACHINE TOOLS.

No. I.

A COMPARISON OF THE CONDITIONS SURROUNDING THE TRADE.

In writing on a subject in which the merits of the productions of two different countries are discussed and compared, one is liable, or, rather, certain to put forward opinions with which many will not agree. The object of this and the following articles is to point out some of the differences in the systems and conditions of British and American manufactures, in the hope that the discussion of this subject may suggest points in which our methods may be improved. With this object in view, it is necessary to emphasise what is good in American machinery and systems of manufacture, for it is the good features which we must consider, the bad being without practical interest for us. Thus the opinions expressed hereafter may without this explanation have an appearance of stronger bias towards American productions than is intended. It is well also to explain at the outset that though largely interested in the use of machine tools of all kinds, the writer has no other connection, directly or indirectly, with any firm of machine tool makers, either in Great Britain or America.

That the Americans have become our serious competitors in the manufacture of machine tools is now generally admitted; and there is no doubt that this most important industry, once practically a monopoly of this country, is in danger of being considerably further diminished, if not taken away from us altogether. Below are given figures representing the aggregate value of machinery imported during the last few years into this country from the United States, by four of the leading firms here, who collectively may be said to represent most of the principal makers of American machine tools:—

Year.	£
1895	86,165
1896	174,849
1897 (year of the strike)	337,528
1898	312,960

Judging by the orders received up to the present date, it is expected that the importations by these firms for the present year will amount to a total value of £378,000.

These statistics not only show that the importation of American machinery is steadily and rapidly increasing, but that the trade evidently received a very considerable additional impetus during 1897, the year of our engineering strike, which fact is worthy of notice. In view of these figures, it is well to consider what has led up to this state of affairs, and what steps should be taken in order that we may preserve our trade, for, if the importation of American tools into this country, the birth-place of machinery, is increasing, it is reasonable to assume that the American trade is also improving to at least a similar extent in other civilised quarters of the globe. A fair comparison, therefore, of the machines themselves, and the methods of manufacture employed by both countries, will perhaps enable us to form an idea as to our prospects of being able to hold our own in the future.

The considerations which influence a purchaser in the selection of a machine tool are as follows:—(1) Its efficiency; (2) its durability; (3) its price; (4) the time in which it can be delivered; (5) the manner in which it is offered for sale. Of the first of these both countries may reasonably claim their fair share. On the second, this country has perhaps the advantage. As to price, there is no doubt that the Americans can under-bid us, and, indeed, the fact that they can often pay the expenses of an office in this country, besides transporting their goods some thousands of miles, and still compete with the makers here, is sufficient proof of this. In delivery, we are, as a rule, the more backward; while with regard to the last item, it must be admitted that the Americans, though not yet so well versed as we are in the methods of conducting business in foreign countries, are more energetic and pushing than ourselves. It is proposed to deal at greater length with each of the above items in subsequent articles, but for the present it will be sufficient, without drawing a close comparison between the two countries, to mention generally the causes which have led up to the Americans occupying their present high position in the engineering world.

The natural advantages of the country itself are too apparent to require comment, producing as it does all the raw material requisite for the manufacture of everything appertaining to engineering equally good in quality and at as low a cost as we can produce it ourselves,

with the important exception of tool steel, which it is gratifying to know is still exported from this country to America in large quantities. In spite of the distance of the producing centres from some of the large manufacturing towns, the Americans manage to transport material at a very low rate. This is due to four causes:—(1) The natural facilities of the country, the numerous rivers and waterways affording a cheap and easy means of transport. (2) The keen competition between the various railway lines. (3) The excellent organisations existing among the manufacturers—such as the National Manufacturers' Association—which have for their object the advancing of the interests of their members, who, combining for this purpose, form a powerful body whose proposals and suggestions are treated with a respect and consideration which no single individual or private firm acting alone can command. (Lastly) The influence of the Inter-State Commerce Commission, a body which, having control of the traffic on the railways between the various States, establishes a uniform rate per mile, and prevents any extra privileges being given by the railway companies to large firms to the detriment of smaller concerns, and enforces the same rate for short as for long distances.

The following table will give a good idea of the average cost at which finished machinery can be transported by rail from the manufacturing towns to New York for shipment, as compared with the rates charged by our railways to convey goods from London to our sea ports. It will be seen that, instead of having a uniform rate, the Americans charge a different price for goods less than three tons, and that goods which are packed are carried cheaper than those which are unpacked.

To New York from	Distance.	Rates per ton.		
		Unpacked machinery under 9 tons weight.	Packed machinery under 9 tons weight.	Lots of machinery over 9 tons weight.
	Miles.	£ s. d.	£ s. d.	£ s. d.
Boston	223	1 11 10	0 18 9	0 15 0
Buffalo	424	1 16 6	1 10 11	0 15 0
Hartford	113	0 18 9	0 15 11	0 9 4
Philadelphia	89	0 0 7	0 16 10	0 10 8
Washington	228	3 6 6	1 8 1	0 15 0
Cincinnati (Ohio)	758	3 0 11	2 13 5	1 4 4

To compare, therefore, the above rates, it is necessary to take the average of the three tables as shown in the following schedule:—

Rates in England.			Average rates for corresponding distances in America.		
From London to	Distance.	Rate per ton.	To New York from	Distance.	Average rate per ton.
	Miles.	£ s. d.		Miles.	£ s. d.
Liverpool	201	1 5 0	Boston	223	1 11 10
Glasgow	401	2 12 6	Buffalo	424	1 7 6
Bristol	118	1 2 6	Hartford	113	0 14 8
Southampton	79	0 5 0	Philadelphia	89	0 16 0
Hull	181	1 5 0	Washington	228	1 16 6

From the above it will be seen that the general conditions in America from a manufacturing point of view are at least as favourable as those in our own country.

We will now consider the character of the people themselves. The American is essentially a business man, and, above all, never loses sight of the fact that he is in business for the purpose of making money. To succeed in this he recognises that he must produce the best possible article at the lowest possible price, and he is therefore more ready than we to lay out capital, sometimes rashly, to attain this end. An English manager who buys a new machine or makes an expensive apparatus in order to cheapen the cost of production, should it turn out a failure, will certainly hear of it from his directors. In America an experiment of this kind is often looked upon as a legitimate trade expense, and it is not uncommon to hear an engineer remark of a certain type of machine that he has tried it, and having found it of no use, has relegated it to the scrap heap. By this he does not necessarily mean that the machine will not do its work well, but that he has found something which will answer his purpose better, in which case he does not hesitate to purchase the new tool. In fact, with him it is not so much a question as to whether he can afford to buy a new machine as whether he can afford to do without it; for he is well aware that a manufacturer now-a-days who intends to make money must spend it freely on his equipment.

It is in this spirit of enterprise, carried sometimes to a point of rashness, that the Americans as a nation differ so essentially from ourselves; and while, no doubt, the individual may sometimes suffer from want of caution, it is in the nature of things for the survivors to profit by the mistakes of others, and without doubt it is largely owing to this characteristic that the Americans have advanced of late years with such extraordinary rapidity.

Anyone interested in the question of manufacture who visits America cannot fail to be impressed with the courtesy of the business people, and the freedom allowed to a visitor wishing to see over any works or factory. An introduction is unnecessary. It is sufficient to send in a card, and permission to view the works is readily granted; nor is there any tendency to withhold information; quite the contrary. Usually a member of the firm will accompany the visitor, explaining in detail anything of special interest, and pointing out any novelties and improvements. It is rare, indeed, after a visit of this description, to leave without having seen a good deal to admire, and without a gratifying feeling of having added somewhat to one's own experience. Having visited over a

hundred factories in the United States, the writer is unable to recall more than one instance in which admission was refused, and this was where a new process of special manufacture, almost in the experimental stage, was being developed.

This practice of welcoming visitors is not confined to foreigners only, but is equally extended to their own fellow-countrymen, and even to competitors. It is not too much to say that in America nearly all the largest manufacturers of machinery are not only acquainted with one another, but in many cases are intimate personal friends. The result is that when business calls an engineer to a town where a competitor is established, he will usually find time to pay him a visit, exchange ideas, and go over his factory. Consequently both obtain some fresh notions, hear what their competitors are doing, and receive an additional stimulus which cannot fail to be of advantage to the engineering community at large. And manufacturers obtain success, not so much by adopting a good method and concealing it from others as by improving upon what others are doing, and endeavouring, if possible, to maintain the lead. Owing to the long distances to be traversed, and perhaps to the excellent travelling accommodation, the average American thinks less of a twelve-hours' journey than we do in this country of a fifty-miles ride; and one is amazed at the accurate knowledge often displayed with regard to the doings of a competitor perhaps a thousand miles off. Moreover, as he invariably travels long distances by night, the American loses little time in going from one place to another.

The system of technical education of the more wealthy among the engineering classes differs considerably from our own. Indeed, the social conditions existing in America are so different from those in this country that it is most difficult for us, with our class traditions, to realise them. As a child, the son of an American employer is frequently educated at the same school and on precisely the same terms and footing as the sons of his own workmen, and hence, from his surroundings and associations, develops a commercial instinct which does not exist in the average schoolboy in this country.

The "gentleman apprentice" is not known. The embryo engineer, on leaving the school, does not pay a heavy premium to learn his business in an engineering workshop, but usually spends some years at one of the excellent technical schools, of which there are several in the country, where he learns a good deal of theory, combined with practice, after which he will obtain a situation as working hand in some firm, commencing at the lowest stage, and rising as rapidly as his industry and ability will permit.

Although we boast some technical schools in this country, they are not yet up to the mark, and the engineer, recognising this fact, prefers to educate his son professionally by apprenticing him to a firm of good standing, where he will have the opportunity of acquiring a thorough knowledge of his business. The result is that the majority of pupils at our technical schools are sons of people outside the engineering world, and on leaving the school (with no matter how good a record), having little or no interest to help them to a situation, find it difficult to obtain work even as unskilled hands, the prejudice being in favour of engaging mechanics from among the working rather than the more highly-educated classes.

As things are, both the English and American systems of training have their advantages. In the case of the former, the premium apprentice leaving school without that commercial instinct which appears to be part of the American boy, comes at once in touch with a business concern, and sees engineering conducted on commercial lines—a state of things widely different from the manufacturing of small articles in the workshop of a technical school for the admiration of his relatives at home.

On the other hand, it is contended that a youth, whose parents have spent a large sum for the privilege of having him taught, is not made to work as he would be under masters at a technical school, that business punctuality—and to be at work regularly at six o'clock in the morning is a severe test—is not insisted upon, and further that he has no opportunity, unless he is sufficiently interested in his work to attend night classes, of learning anything of theory while serving his time. Be this as it may, it is evident that both systems are good from the fact that each produces good men.

SOME NOTES IN RUSSIA.

(From a Special Contributor.)

VI.—RAILWAYS AND WATERWAYS.

If one desired a comprehensive single-sentence definition of Russian railways, to call them "both the best and the worst in the world" would not be much beside the mark. To the Englishman, brought to Russia on business, a Russian railway may represent the quintessence of what should not be; but regarded from some other standpoints—not necessarily entirely Russian either—we might copy some things with advantage. So far as Russia herself is concerned, the railways are admirable; the country is happy in this, that time is not money there, and only comfort needs consideration. To compare a Russian with a British railway is, therefore, for this reason, idle.

In one way and another Russian railways have lately come in for a good deal of description, the repetition of which here would be of no particular advantage. I propose, therefore, to confine myself as much as possible to certain minor details of interest to which attention is seldom or never directed, viewing the matter entirely in the light of the traveller.

The speed of Russian trains is a subject by now worn tolerably threadbare; most people are cognisant of the fact that twenty-five miles an hour represents something

like a speed maximum. The reasons—of which one hears less or nothing—are twofold.

In the first place, Russian lines are laid very often upon sandy or marshy soil, and a high speed might produce disaster. It is worthy of note that railway accidents—other than the purely national ones caused by explosives, and intended for the Imperial family—rarely occur in Russia. A second reason is that the lines being mostly as unprotected as the prairie lines in America, both moujiks and animals often stray upon the railway, and the train has to stop till they can be persuaded to move away.

When all is said and done about speeds, however, there is one thing to be urged for Russian trains—they are always punctual. With their slow speeds and stoppages that vary from fifteen minutes to an hour, the contrary would not perhaps be easy. The starting of a Russian train is a most tremendous business; a bell, then a warning whistle, a second bell, more whistle, then a third edition of both. Despite this, however, there are folk who contrive to miss trains. There is no "pay at the other end" for the passenger who arrives at the last moment. No one may travel without a ticket. At St. Petersburg, for the expresses, it is necessary to be at the station something like an hour beforehand if one has luggage; even a first-class passenger is only allowed the veriest trifle free, the rest has to be paid for at high rates, measured, it has been suggested, by what the authorities, after looking at the passenger, thinks he can afford to pay. It is a lengthy operation. Leaving a train, too, is a matter of nearly an hour in the case of people with luggage. There are no station cabs, the omnibuses from the chief hotels and ordered vehicles only are allowed to enter the station precincts; nothing is witnessed like the every-day scenes at any London terminus.

Wirballen, the frontier station opposite Eydtkuhnen, is one of the best known in Russia. Here, in consequence of the different gauge, all passengers have to change. The frontier is lined with sentries upon the banks of a small river, the German side of which is flat marsh land for a good hundred miles. On the Russian side there are

from Ostend—or Calais—to Petersburg is £4. The extras by ordinary express come to more than half this, when the additional expense of a day's extra food is counted, so the excess is very slight, and by no means disproportionate to the advantage. The Nord travels little if at all faster than ordinary expresses; it makes up time chiefly in Russia by the absence of long stops for refreshments. At night, by the way, the Russian part of it is lit just like all other Russian trains, with a solitary candle.

Russian bridges are mostly of wood. There are few, if any, bridges of the kind so plentiful in Germany, where some of the finest looking bridges in the world can be found. Directly one enters Russia these vanish, to be replaced by dumpy wooden structures, such as might be found on small British local railways.

Russian locomotives are curious things; England, America, and Germany chiefly provide them. Some of these locomotives, at a little distance, do not look very unlike "Puffing Billy"—they suggest that engine at any rate. Others recall our Metropolitan Railway. All burn wood, petroleum, and rubbish, and discharge an abnormal number of sparks. There is said to be only one Russian-built express locomotive, and this came to grief on its first trial—smashed a connecting-rod, or some such accident; so there does not appear to be much probability of foreign-made engines being ousted yet awhile. British engines are regarded as the best, but German are most used. I heard several stories of old or defective engines having been palmed off on Russians by Germans, but do not know whether they are true, or if true, more than in a few isolated instances. The strong national hatred of Russians for Germans might account for the tale. On the other hand, there are plenty of instances of the same sort of thing in other trades. Russia is somewhat of a "dumping-ground" for the Germans, a practice that tells in favour of our rivals at present, but which must eventually tend to our benefit.

The first Russian railway, from Petersburg to Zarskojeselo, was opened in April, 1838. Its length was only 17½ miles. It was a single-track line, very solidly constructed, at a cost of £12,000 per mile. It at once paid,

route is, however, abandoned, and the line will now run from Vladivostok to Kiranova, thence to Petuna, where it will join the line to Mukden and Port Arthur. A projected line runs from Mukden to Pekin. It is more possible than probable that the whole line will be open in 1905 as projected. There are enormous difficulties of all sorts. However, the railway is a State affair, and the Russian is a person of abnormal persistence. Somewhere along the route gold has been found, but there is little trustworthy information about it. Whether it is much

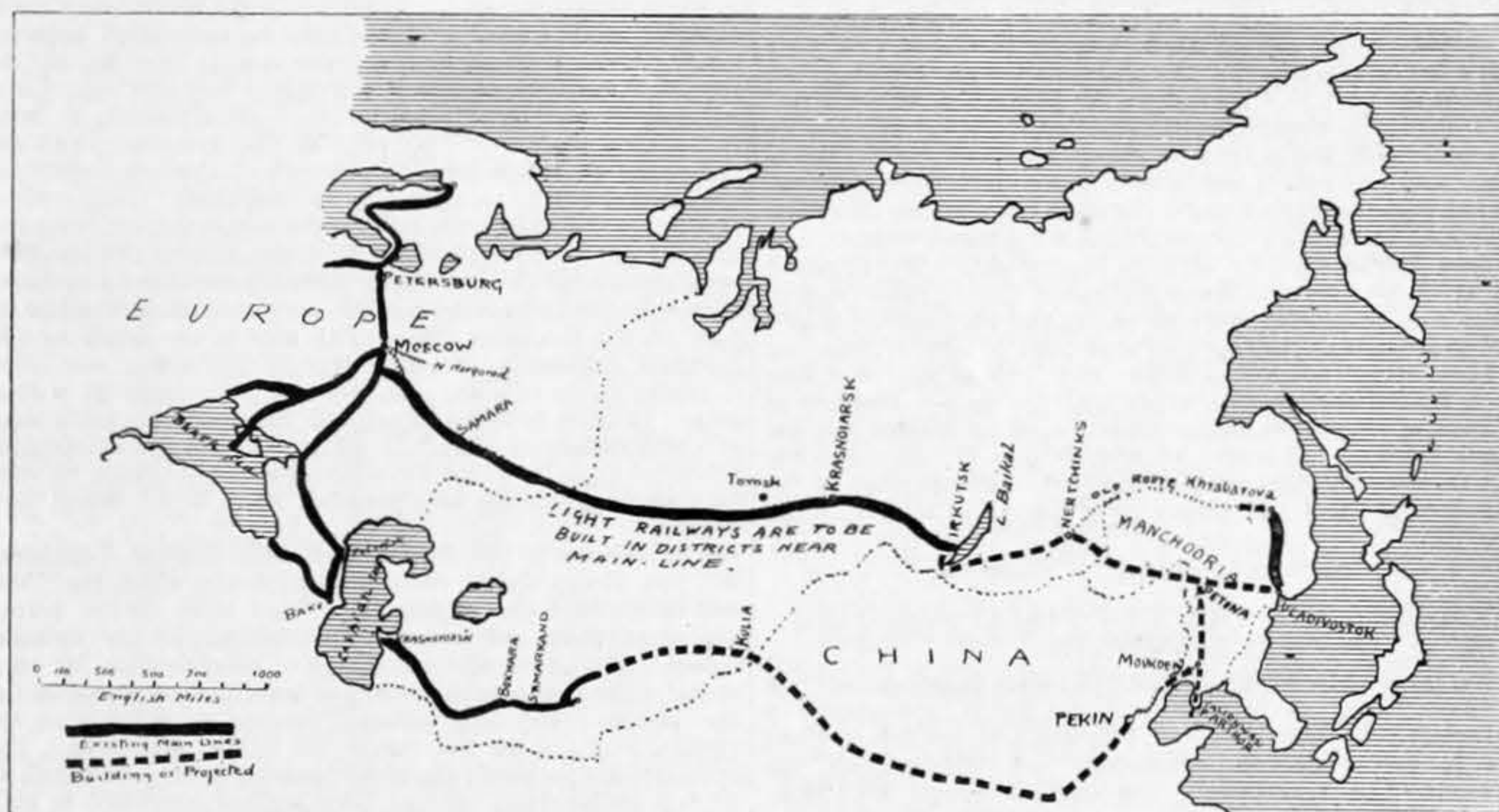


Fig. 1—RUSSIAN RAILWAYS TO CHINA

fir forests and the everlasting flat plains alternately. Wirballen station is equal to any in this country. The customs-house is fairly quick, the ordinary passenger is little bothered—not a whit more than he is elsewhere—and the long wait is more Russian than necessary.

The ordinary expresses are chiefly made up of wagon-lits, for which a supplementary fare must be paid. A first-class passenger can travel on in a second-class wagon-lit if he does not care to pay the first-class "supplementary." Roughly, the first-class is 16s. from Wirballen to Petersburg, the second class 11s. Probably he pays the first, and goes by the second; there is not much way of telling. The latter for the stranger is, indeed, the best, since by it he will meet the British "bagmen," who are almost the only people from this country who go to Russia—or who know much about it—and Russia is a land where the railway passenger needs advice. Some of these commercials have grown grey in the service. No one finds out very much as to what they do or where they go; secretiveness is the order of the day with them, but there is no doubt that many of these old hands carry on a lucrative trade in machinery of different sorts. The carriages are the usual wagon-lits, a corridor on the left hand, the compartments to hold four each, a lavatory at either end, and a passage into the adjacent cars. There is no dining car in the ordinary express, but the inevitable tea—stakan tchi—can be procured on board at any time. For meals stoppages are made at various stations where excellent restaurants exist. Russian trains are lit at night in a most primitive fashion—a single candle suffices for a compartment. Between first and second-class cars there is little, if any, difference; but the third-class are bare wood, each compartment having four shelves and some straw. The moujiks pack themselves in these as they fancy. The whole train is well heated with charcoal fires—rather too well heated very often.

The best train in Russia is the Nord express, which runs through from Ostend to Wirballen, and thence to Petersburg two days a week. In this way one can get from London to Petersburg in about fifty hours; by the ordinary through express the journey takes something like three and a-half days. The Nord is made up entirely of first-class wagon-lits, and the supplementary charge

8 per cent. being got from it. M. de Gerstner was its engineer. In 1845 the Petersburg-Moscow line was begun; 400 miles, at a cost of about £2,900,000. Other railways in working order or building before the "fifties" were Moscow to Kolomna, 66 miles; Warsaw to Cracow, 156 miles, for half a million pounds; Petersburg to Odessa, roughly a thousand miles down the 30th degree of longitude, was projected in 1848, but never came to anything; in place of it, Moscow was connected with Sevastopol as a main line at a much later date. The earliest line was extended to Wilna, whence it went on to Wirballen and to Warsaw. This latter place was connected with Moscow, whence the line was carried to Nijni Novgorod. A main line runs from Kharkov to Nikolaieff. A main line also runs from Moscow to the Sea of Azov, thence to Petrovsk on the Caspian, and an extension to Baku is now open. From Baku a line runs to Batum. On the other side of the Caspian the main line runs from Krasnovodsk via Askabad, Merv, Bokhara to Tehemkent, and Kokan in Turkestan. It is thence projected to Kulia on the frontier, and down across middle China to Pekin. The famous Trans-Siberian Railway may also be said to start from Moscow via Toula to Samara on the Volga; thence it runs to Irkutsk on Lake Baikal. The accompanying sketch maps, Figs. 1 and 2, will help to make all this intelligible. This past summer excursions were run with a special train-de-luxe from Moscow to Krasnoiarsk. The charge, everything except wine included, was a little under £60, which, as it lasted from the 5th to the 24th of August, cannot be called very heavy.

The whole of the details published concerning progress on the line beyond Lake Baikal need careful acceptance, and Krasnoiarsk may still perhaps be regarded as the virtual terminus. A great deal of the line has been laid on sand, and will have to be re-laid before fast or heavy trains can be run upon it. A large amount of peccation was at one time practised; and more than once it might have become a Panama Canal but for the energy of the projectors. The difficulties that have been encountered are far heavier and more varied than is generally supposed, and the expenditure one way and another has been colossal.

From Vladivostok, the original terminus, the line has been working to Khabarovsk for just two years. This



Fig. 2—RUSSIAN RAILWAYS AND SHIP CANAL

or little, the Russian Government is sure to take care that if any Johannesbergs arise they will be Russian towns.

The railway is assumed to be a purely military one. It is not. It will have military uses, but by no means such great ones as is assumed. The Russian ideal of strategy is to be leisurely; in such an enormous country this will pay better, and it is at least open to doubt whether purely military reasons would ever have produced the line—a bruised reed for military operations.

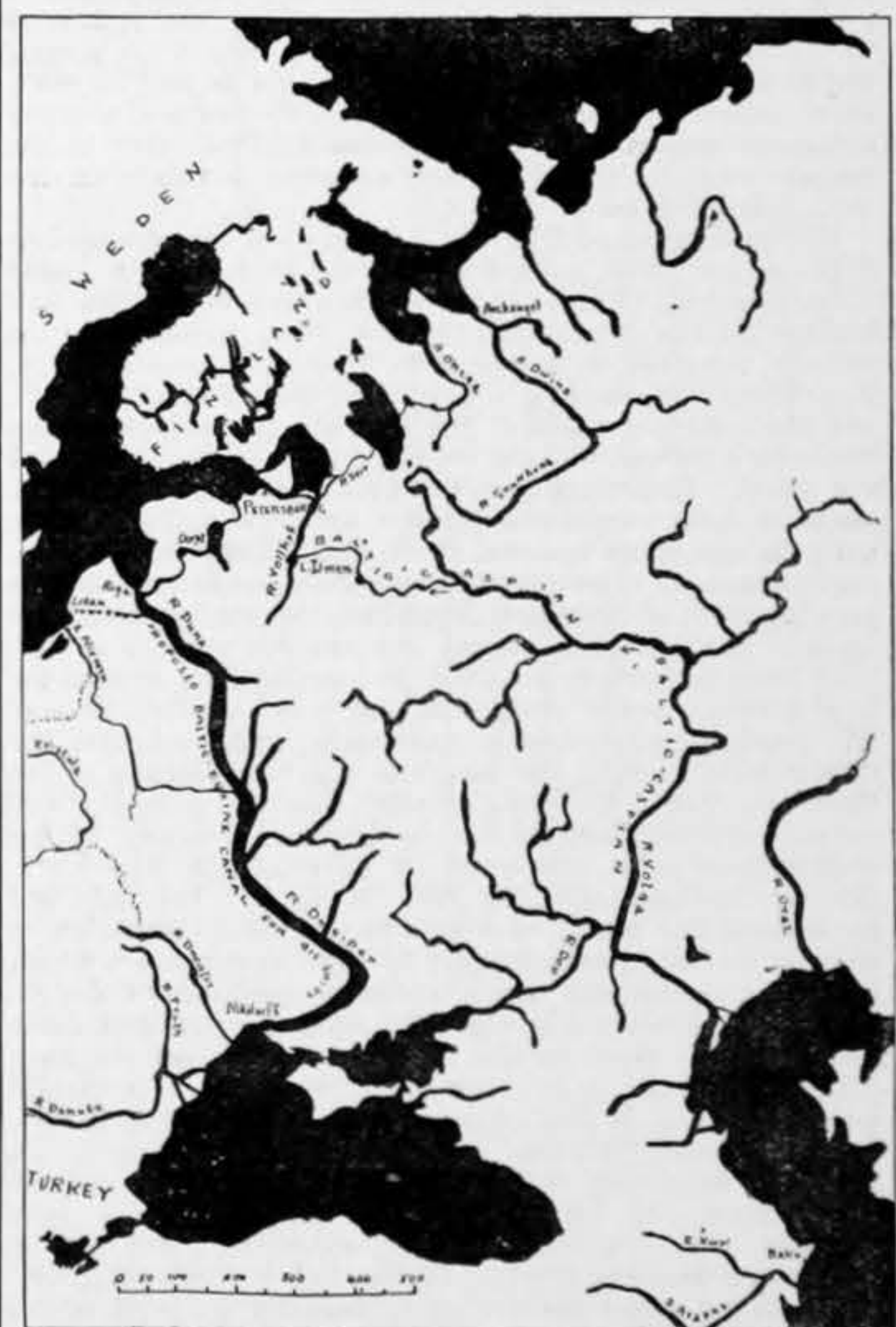


Fig. 3—RUSSIAN WATERWAYS

Siberia, however, is to the Russian moujik much what London is to the pauper alien—it is a promised land flowing with milk and honey. For literary purposes we always paint Siberia as an awful frozen land, to which despairing Russians are sent in convict droves. A certain number of people who would be executed in other countries are thus sent, but of the 60,000 who went in 1898, only a very small percentage were convicts. The rest were free emigrants. So great is the desire to go, that many emigrants have tramped all the way to the Amur province, a three years' journey.

The fact is, that much of Siberia is extremely fertile, and to all intents and purposes it is Russia's Canada. It is a country of boundless possibilities, as yet virgin. The railway is needed to open it up, and its *raison d'être* lies there.

Fares on Russian railways are very low—a species of zone system is in operation; 3000 versts, roughly, 2000 miles—1899 is the exact figure—can be traversed for about £2, against the £8 odd it would be by our parliamentary trains. On the Trans-Siberian Railway the first-class supplementary fare is about 5s. 6d. for a single night, and little over a pound for six—the time taken in reaching Krasnojarsk from Moscow.

Nearly all railways are State owned; such as are not are in process of being so. At the end of last year 27,644 miles of railway were open, and 7426 building. Canals and waterways are intimately connected with railways in Russia. The projected Baltic-Euxine Canal has been dealt with in a previous article. For mercantile purposes this waterway already exists, thanks to the big rivers and junction canals. Siberia has some 28,000 miles of navigable rivers, and there are waterways across a great deal of Siberia—see Fig. 3.

Numbers of canals were projected by Peter the Great, and finished by his successors; and eighty years ago there were fourteen principal canals in European Russia. This included the Baltic-Euxine waterway completed in 1801. It united branches of the Dnieper and Duna; the artificial part of the waterway is less than twenty miles long. Nature has done the rest.

HARBOURS AND WATERWAYS.

Montreal.—The first of the piers which form part of the works for the improvement of the harbour of Montreal has been completed, and the Dominion steamship Roman berthed there, the captain expressing the opinion that this pier "was superior to anything outside of Liverpool." The pier is 1000ft. long, 300ft. wide, with 30ft. against the walls at low water. It runs out at an acute angle from the main harbour wall and street which runs parallel with the harbour, and is to be succeeded by others constructed in a similar manner. The pier is built of crib work, and was commenced about a year ago. The cribs are 15ft. long, the front compartment, 9ft. in width, being filled with stone, and the remainder with material dredged from the harbour.

The works of which this pier forms part, after a long period of negotiation between the different authorities concerned, and a very strong controversy as to the merits of numerous schemes submitted for approval, were finally commenced in 1891. The scheme was designed by Mr. John Kennedy, M. Inst. C.E., the harbour engineer, to meet the requirements of a rapidly-growing trade, and for the protection of the city from floods caused by ice blockades. By this project the upper part of the harbour has been enclosed by an embankment $1\frac{1}{2}$ miles in length, enclosing 250 acres, which by this means is protected from the strong current of the river, and from the violent action of the ice coming down the stream on the break-up of the winter season. This embankment, or "guard pier," is 45ft. in width and 20ft. above low-water level, and is composed of the material removed in dredging the harbour, the face being pitched with stone, about one million cubic yards being required. The estimated cost of this guard pier was £624,000. In connection with the material used, a rather singular dispute occurred between the municipal and harbour authorities, who in certain proportions found the money for the work, as to the proportion of payment. The quantity originally required was estimated by "scow measure," that is, the cubic contents of the barges; but as the work went on, it was found that it took $1\frac{1}{2}$ yards scow measure to make one cubic yard in position, a much larger proportion than was anticipated. One party to the bargain declined to pay on scow measure, but only on the work actually done.

Within this Guard Pier the harbour has been dredged to 27 $\frac{1}{2}$ ft. at low water, a depth which can be further increased when required. The Lachine Canal connects with the new harbour at the upper end, and the water from it and the mills on the river is sufficient to keep up a constant flow. The main street fronting the new harbour is to be widened, and the low-lying parts of the city will be protected from floods by a parapet wall carried along between the streets and the wharf. Projecting from this roadway, at an acute angle, are to be three piers similar to that already described, giving, with the new shore wharves, about 15,000 linear feet of deep-water quayage. These works have been necessitated by the growing trade of Montreal, about half the import and export trade of the Dominion passing through this port. The harbour has now become the chief port in Canada. It is at the head waters of ocean navigation, and is the meeting-place of the grand inland system of navigation connected with the Great Lakes; and is the terminus and headquarters of the Canadian Pacific Railway Company, controlling nearly 9000 miles of railway; and of the Grand Trunk Railway, having 5000 miles. It is connected by railway with New York, Boston, Portland, Halifax, and St. John. Its trade and importance as a centre of distribution for the Dominion of Canada is due almost entirely to the improvements which have been carried out in the navigable conditions of the St. Lawrence. Montreal is 986 miles from the Straits of Belle Isle, and is situated at the head of that part of the river which is navigated by ocean-going steamers. Originally owing to shoals in the channel, vessels drawing over 10ft. could not reach Montreal during low water in autumn. In 1844 the deepening of the river was undertaken by the Government. In 1865 a channel 20ft. deep had been attained. In 1878 this was increased to 22ft., and 25ft. in 1882; and in 1888 27 $\frac{1}{2}$ ft. was secured at ordinary tides, which do not affect the channel beyond Three Rivers, about 70 miles below Montreal. Since then a depth of 27 $\frac{1}{2}$ ft. has been secured all along the channel at the lowest water in autumn, at the part of the river which is beyond the influence of the tides.

The shipping traffic has grown as the dredging improved the navigable depth, and increased from 629 sea-going vessels, of a tonnage of 693,854, in 1883, to 734 vessels, of a tonnage of 1,096,909 in 1894. The average size of the vessels increased from 1087 tons to 1495. The inland vessels numbered at the latter period 4666, with a tonnage of 979,809 tons.

The trade of Montreal will no doubt be further increased as the facilities between the St. Lawrence and the inland lakes become improved. One very important step in this

direction has been accomplished within the last few weeks by the opening of the Soulages Canal, connecting Lake Ontario with the river, and forming the last link in the chain of improvements which the Government have for some years past been carrying out, at a cost of about £13,000,000. Boats drawing 14ft. of water can now pass from the sea to the lakes. By this operation the cost of transporting lake freights to tide water can be reduced to a level beyond the possibility of competition by the American waterways.

Russian ports.—The statements which have recently been in circulation as to the effect that the proposed canal for uniting the Black Sea and the Baltic was to be commenced forthwith, and that contracts had been entered into for its construction, do not appear to be correct. The *Times* correspondent at St. Petersburg, on the authority of the Assistant Director of the Maritime Section of the Russian Ministry of Finance, says that the plan of this canal has not yet even emerged from the region of projects. It is not considered probable that this colossal enterprise, which is estimated to cost nearly £24,000,000, will proceed beyond its present projectory stage before the completion of the great Siberian Railway. The Imperial Exchequer is already overburdened with the financial responsibilities of this great railway and other costly works in the Far East.

A statement to the effect that the Russian Government intended to close the principal ports in the Black Sea, the Baltic, and the Far East, to shipping in 1900, seems to be equally without foundation. It has been determined to separate as far as practicable her great naval arsenals and fortresses on the seaboard from her commercial ports, and for this purpose Sevastopol is to be closed to commercial vessels this autumn; and the accommodation at Kronstadt for trading vessels will in the future be very much more limited than it is at the present time. To compensate for this a new port has been created twenty miles further inland and nearer St. Petersburg, but even with this the accommodation for merchant vessels trading to this part of Russia is very limited, and frequently a large number of vessels is obliged to lie out at sea waiting for vacant berths, and foreign shippers are beginning to object to send their steamers to St. Petersburg, unless at very high freights, owing to the serious delays to which they are exposed. In the meantime the port of Libau is being built and equipped for commerce as well as for a winter station for the Baltic fleet. Windau and Pernau are both to be improved for trade. Novo Rossisk, on the Black Sea, a port through which nearly 400,000 tons of grain and other merchandise pass in the year, is offering increased facilities of every kind to foreign shipping; Mariopol, on the Sea of Azoff, is being furnished with piers and other appliances for the convenience of shipping. As regards the port of Nikolaieff, in the Black Sea, where three-fourths of the vessels trading are British, great complaints are made as to the growth of a large sandbank, which forms a bar, and prevents vessels drawing over 18ft. from crossing. As the vessels carrying grain, the chief export from this port, generally draw 20ft., this sandbank is a great hindrance and danger, frequently from three to four vessels being stranded on it at one time. The attention of the Russian authorities had frequently been called to the growth of this bar, but so far nothing has been done to dredge it away.

Three important works in the South of Russia have now been finally elaborated for examination by the Minister of Ways and Communication, namely, the excavation of a sea canal between Kherson, at the mouth of the Dnieper and Odessa; the deepening of the port of Tanganrog, in the Sea of Azoff; and the deepening of the Kilia branch of the Danube.

ENGINES FOR THE SHEFFIELD ELECTRIC TRAMWAYS.

WE give this week as a supplement drawings of one of two pairs of vertical engines which are about to be erected for the Sheffield City Council, which engines are to drive electric generators for transmitting the power to the tramways. The engines are of the slow-speed type, and the construction of this particular type of engine by home makers has been the subject of much controversy at Glasgow and elsewhere, and they are therefore particularly interesting in showing the results of one British maker's investigation into the stress which is likely to come on slow-speed direct-connected traction sets.

Mr. H. W. Morley, of the firm of Cole, Marchent, and Morley, Limited, of Bradford, the builders of these engines, writes us as follows respecting their design and proportion.

"The engines are designed to drive a 500-kilowatt electric generator, which generator has been supplied to the Corporation by the British Thomson-Houston Co., of London, and made by the General Electric Company, of America. The normal load of the engine, reckoning efficiencies, will therefore be, under ordinary conditions, about 780 indicated horse-power; but the condition of working of the machine is that the engines should be capable of safely turning 1000 indicated horse-power, with a boiler pressure of 150 lb. per square inch, and working either condensing or non-condensing. These conditions are very onerous. The great advantage of the slow-speed generator is that, for short periods, it can carry a very heavy overload, and momentarily, generators are made which can carry 100 per cent. overload. It is the endeavour of engineers of electric tramway generating stations to put down a unit for the mean load, and thus there have arisen for tramway work the terms normal; or mean load, overload, and momentary maximum load; and with the heavy generators the point of most economical working of the generator is generally about the point of most economical working of the engine, and the overload on the engine becomes a question of adjusting the cut-off in the cylinder to suit these overloads.

As regards the stresses on the engine due to the variations of load, if the engine is designed for its maximum load on the low-pressure cylinder, and for its minimum load on the high-pressure cylinder, adopting the usual factor of safety which stationary engine builders use in their best practice, no further stresses can be put on to the working parts due to the steam pressure, but with variable loads the boilers are more liable to prime, and this requires additional precaution in the proportioning of the parts, and the drainage of the cylinders. The variations in load also have an effect on the bearings, which require to be of more ample proportions than the usual practice.

"The engines illustrated are arranged to run at a normal speed of ninety revolutions per minute. The high-pressure cylinder is 20in. diameter, the low-pressure cylinder is 40in. diameter, and both are 3ft. 6in. stroke. The piston-rods are 4 $\frac{1}{2}$ in. diameter, and the crank-pin journals 6 $\frac{1}{2}$ in. diameter, by 8in. long. The fly-wheel is built up in sections, having a separate boss, eight arms, and eight separate segments. The

boss is constructed in a similar way to that illustrated in your paper on January 14th, 1898, and the arms are secured in the same manner. The rim, however, is secured together at the joints by arrow-headed tie bolts, and the section of the rim is adjusted so that the reduction in section for the tie bars does not materially affect the strength of the wheel, the metal being taken out by cores in other places to allow for this. In several American wheels, which I calculated when in America, I found that the reduction of section by these arrow-headed bolts amounted to 40 per cent. The wheel is also proportioned for bending between the arms. No piece of cast iron in the fly-wheel, under normal running conditions, is stressed above 1000 lb. on the square inch. Even in the best conducted establishments accidents happen, and it is not an uncommon occurrence in some districts for short circuits to take place in the line, and, in spite of the most wonderful contrivances, for the load to be thrown back on to the generator. In cases of very heavy short circuits not only has the generator behind it a known and limited power of the steam engine, it also has the energy of the fly-wheel, and in cases of very sudden short circuit the energy of the fly-wheel is of very considerably more account than the power of the engine. To take these sudden stresses and also to strengthen the shaft in a way which I will refer to later, a flange is cast on the side of the fly-wheel boss, and a flange of similar dimensions is also cast on the armature spider. The two are accurately machined and securely bolted together on the shaft. The stresses then are transmitted from the fly-wheel to the armature by means of this coupling, and the shaft is entirely free from any torsional stresses, which are to be transmitted from the fly-wheel to the armature. With reference to the crank shaft, this requires to be of very ample proportions, but I am rather of the opinion that the stresses which it has to carry have been very much exaggerated. For many years in mill practice we have put heavy fly-wheels on to these shafts, and have been used to allowing for the heavy stresses set up, not only those due to the fly-wheel, but those due to the pull of the ropes. The crank shafts of engines for traction work have rather more difficult conditions to fill. Generally, the crank shaft is longer between its supports, and in addition to the ordinary stresses due to the weight, magnetic pull has also to be allowed for. This magnetic pull can be a very considerable quantity, and, I believe, in the generator which is to be applied to our engine the pull on the armature, due to being one-sixteenth out of centre, would amount to eleven tons; if it were one-eighth out of centre, it would amount to about forty-four tons. These amounts would vary under different conditions of load, but may be considered approximate. Arrangements, however, are usually provided on the generator magnets, so that if the engine bearings wear down, the magnets can be adjusted to allow the armature to work in a central position. This pull on the armature does not materially affect the bending strength of the crank shaft, as the armature fits as a sleeve on to the shaft; the fly-wheel also fits in a similar way, and, as above pointed out, they are bolted together by a coupling, thus reinforcing the shaft for bending strength. The shaft, however, requires to be larger than usual so as to give an extra bearing area and allow for part of the magnetic pull. The size of the shaft in the Sheffield engines is 15in. diameter in the necks, and 17in. diameter in the middle. Each of the main bearings is 30in. long. In order to allow for any inequalities in the settlement of the foundations, the main engine bearings are constructed to swivel slightly, which swivel is also an advantage in such long bearings in case one pedestal wears down faster than another.

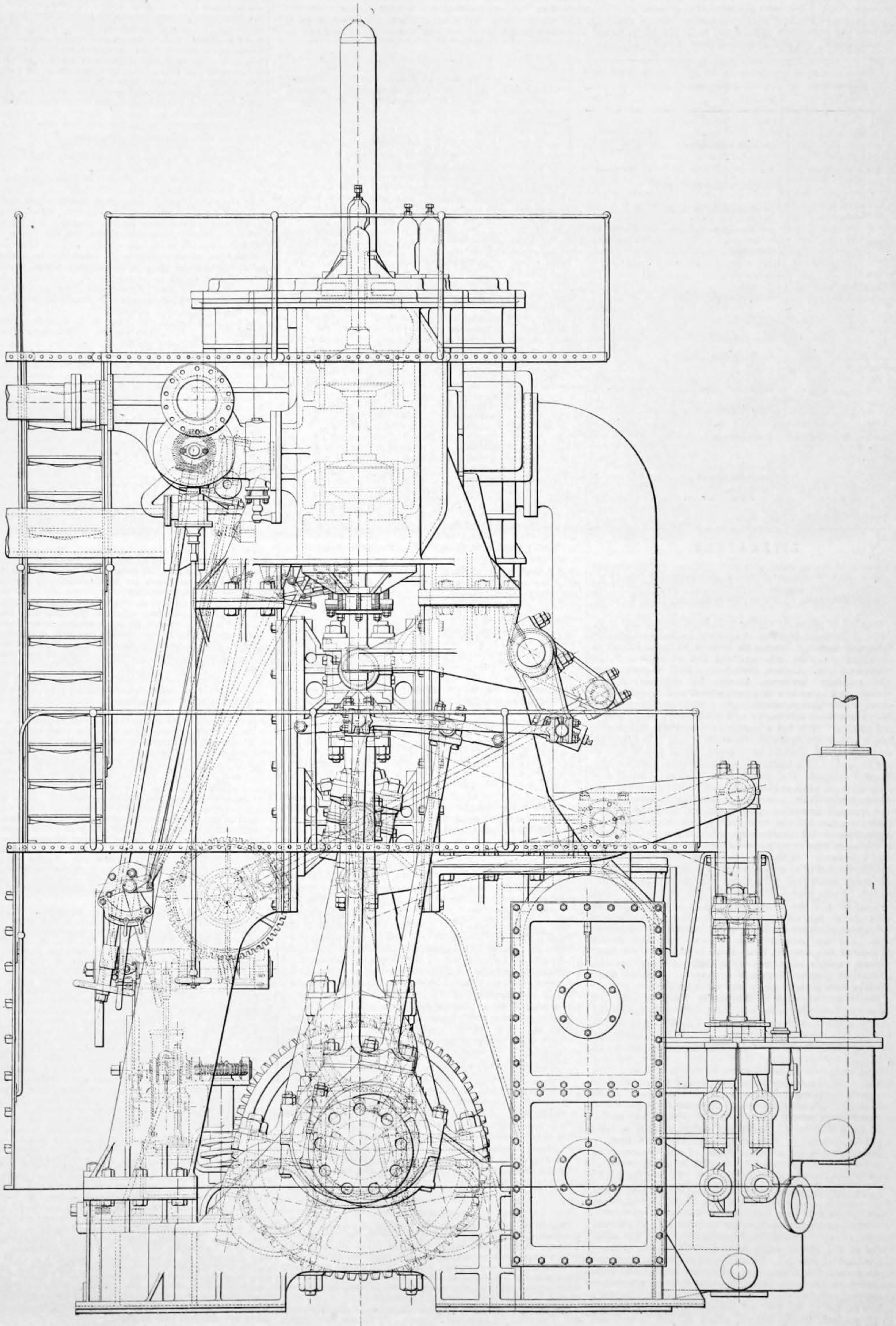
"In addition to the illustrations of the engines, I am sending you also a detail cross section of the cylinders. You will notice that the engines are fitted with Corliss valves, and that these valves have been placed in the cylinder covers. We do not adopt this type of construction for horizontal engines of this size owing to the difficulty of examining the pistons; but this difficulty is not so great with the vertical engines, as the covers are more accessible. The cylinders are jacketed, the steam passing round the barrel on its way to the steam valves. This method is applied to both cylinders.

"I also enclose you a drawing of our improved Corliss gear. The trip motion is similar to the old Spencer-Ingalls type double-clip gear, and retains the balanced feature of that gear in having a double clip or wearing pieces. We have, however, taken the slide rod right through the shuttle, which lessens the wear on the gear, and reduces the weight which the dashpot has to draw back. Wrist plates are used to drive the Corliss valves, as more power can be obtained in opening the steam valve and a quicker opening, and the exhaust valves can be reduced in diameter, lessening the clearance. There are few mechanical motions which require so carefully proportioning as a Corliss gear, and few which have to work under such heavy conditions and have to be controlled with such accuracy. The steam valves would in a mill engine have to open to their full width in about one-third of a second, and would close the steam port in about one-sixteenth of a second. The valves of the high-pressure cylinder would weigh approximately 50 lb., and of the low-pressure cylinder 156 lb. For some time there was considerable difficulty in working Corliss valves at a high speed, owing to their breakage due to quick closing. To increase the weight only added to the difficulty at one place, whilst reducing it in another. We therefore design our Corliss valves as light as possible, prevent them dipping into the ports by a judicious arrangement of guards, and arranging our dashpots with long cushions, which compels us to put more than the usual amount of lap on to the Corliss valve. In the traction engines we use the vacuum dashpots, as we can get more power at the earlier cut-offs and equally prompt closing at the late cut-offs. The engines illustrated are to be enclosed, and forced lubrication is to be used."

BETWEEN January 13th, 1898, and August 13th, 1899, new lines of railway of a total length of 3171 miles were thrown open for traffic in European and Asiatic Russia. During the same period a second line of rails was added to already existing single-track railways to the extent of 265 $\frac{1}{2}$ miles. Thus the total length of railways in the whole Russian Empire on August 13th last was 30,321 miles, of which 5465 miles are lines with a double track. European Russia possesses 15,499 miles of State railways, of which total 4418 miles are double-track lines, and comprise 988 $\frac{1}{2}$ miles of double track. Thus the main railway system of European Russia has a total length of 24,917 miles, including 5406 $\frac{1}{2}$ miles of double-track lines. The secondary railways have a length of 440 $\frac{1}{2}$ miles, inclusive of 16 $\frac{3}{4}$ miles of double tracks. From these figures it will be seen that the entire railway system of European Russia amounts to 25,357 $\frac{1}{2}$ miles, which include 5423 $\frac{1}{2}$ miles of double track. Asiatic Russia possesses 3043 $\frac{1}{2}$ miles of railways, and the Grand Duchy of Finland 1620 miles.

ENGINES OF THE S.S. AMERICA MARU—END ELEVATION

THE WALLSEND SLIPWAY AND ENGINEERING COMPANY, LIMITED, WALLSEND, ENGINEERS



WARSHIPS UNDER CONSTRUCTION IN THE UNITED KINGDOM.

In order to afford a comprehensive view of the shipbuilding in progress throughout the United Kingdom, the following statement of the war vessels which are at present under construction has been compiled by Lloyd's. For this statement, it has been assumed that a vessel may be regarded as "under construction" from the commencement of the laying of her keel to the time when she is ready for her steam trials. Of course, when this latter stage is reached, the guns have usually still to be placed on board, and the vessel to be fitted out, before she is ready to be commissioned; but she is, nevertheless, structurally complete.

Nationality.	Description.	At Royal Dockyard.			At private yards.			Total.	
		Yard.	No.	Displacement.	Yard.	No.	Displacement.	No.	Displacement.
British	1st class battleships	Chatham	2	Tons. 30,000	Barrow	1	12,950	13	184,850
		Devonport	2	30,000	Birkenhead	2	26,950		
		Portsmouth	2	30,000	Blackwall	3	40,950		
	1st class armoured cruisers	Pembroke	1	14,100	Jarrow	1	14,000	9	110,000
		—	—	—	Barrow	2	24,000		
		—	—	—	Clydebank	2	24,000		
	1st class protected cruiser	Pembroke	1	11,000	Glasgow	1	5,600	1	11,000
	2nd class protected cruiser	—	—	—	Glasgow	1	5,600	1	5,600
	3rd class protected cruiser	Chatham	1	2,200	—	—	—	1	2,200
	Sloops	Sheerness	4	3,920	Birkenhead	2	1,960	6	5,880
Gunboats	—	—	—	Liverpool	2	1,400	2	1,400	
Foreign, or not stated	Torpedo boat destroyers	—	—	—	Birkenhead	2	5,720	18	5,720
		—	—	—	Chiswick	1			
		—	—	—	Clydebank	3			
Royal yacht	Pembroke	1	4,700	Govan	2	—	1	4,700	
Total...		—	14	125,920	—	38	205,430	52	331,350
British and foreign	Armoured vessels	—	—	—	Barrow	1	15,200	7	72,740
		—	—	—	Clydebank	1	15,200		
		—	—	—	Elswick	5	42,340		
	Protected cruiser	—	—	—	Low Walker	1	4,170	1	4,170
	Torpedo boat destroyers	—	—	—	Birkenhead	1	300	9	2,920
		—	—	—	Chiswick	1	300		
		—	—	—	Clydebank	3	1,020		
	Torpedo boats	—	—	—	Elswick	2	700	11	1,500
	River gunboats	—	—	—	Poplar	2	600		
	—	—	—	Poplar	11	1,500			
Total...		—	—	—	Chiswick	2	300	30	81,630
Total...		—	14	125,920	—	68	287,060	82	412,980

LITERATURE.

Elements of Precise Surveying and Geodesy. By MANSFIELD MERRIMAN, Professor of Civil Engineering in Lehigh University. First edition, first thousand. New York: John Wiley and Sons. London: Chapman and Hall, Limited. 1899.

ORDINARY or plane surveying may be distinguished from more pretentious geodetic operations by the fact that its sphere of action is usually so limited as to render it unnecessary to take into account the curvature of the earth's surface. Unless, therefore, a civil engineer, like his military brethren, should be engaged in important and extensive trigonometrical and topographical surveys and triangulations, only a comparatively few of the principles of astronomy and geodesy are really essential to him. It is not a matter of very great moment to him whether the figure of the earth is that of a spheroid, an ellipsoid, an ovaloid or a geoid, all of which figures are treated of in a historical and interesting manner, in a chapter towards the end of this volume. The higher principles of both geodesy and astronomy, those of the latter particularly, are special sciences in themselves, and demand therefore special courses of study and instruction, not only in the theory, but in the practical management and manipulation of the more delicate, and at the same time more powerful instruments employed by the operators. Without in any way undervaluing the chapters relating to spherical and spheroidal geodesy, we are more concerned with those of a more practical character. Some useful hints are given in Chapter II. upon the handling of the transit instrument, and much precise information respecting methods for the detection and correction of errors liable to occur in ordinary triangulation. For the measurement of base lines, the author advocates the use of long steel tapes, as they have proved capable of giving exceedingly accurate results, and a high degree of precision may be obtained more cheaply with them than by any other method.

While stating that it frequently happens that the transit and theodolite are employed for levelling purposes in topographic surveys, the author is careful to point out, and repeats his warning on page 230, that the method of running sections by vertical angles is not one to be generally recommended. He remarks—and we perfectly concur with him—"in no case, however, can this work attain a degree of precision comparable with that done by spirit levelling." It may be noticed that in the chapter on "Spherical Geodesy," the honour is awarded to a Frenchman named Picard, as the first to use spider lines in a telescope. There has always existed a good deal of discussion respecting who was the first to introduce cross hairs in the focus of the telescopes of surveying instruments. It is a mistake to suppose that spiders' webs were adopted *ab initio*. They were not in use until about the year 1773, when Fontana advocated their claims. Latterly the credit of employing horse hairs for the first time has been given to an Englishman, William Gascoigne, who alludes to both hair and thread 250 years ago. Picard could hardly have been the introducer of the spider lines, as he himself applies to them the term "cheveux." Recently, in some instances, the cross wires—for silver and platinum have both been included in their manufacture—have been altogether abolished, and fine points of metal or glass reaching only to the centre of the field of vision substituted for them. In all geodetic triangulations, which subject is well and

practically treated in Chapter IX., the main features are common to the engineers of every country, although the details, that is, the mode of applying the common principles, is susceptible of considerable variation. Thus the preliminary reconnaissance, the location of the proposed stations and landmarks, the arrangement of signals for different distances, the observing of the necessary horizontal angles, and the computation of the triangles in both the primary and secondary series of triangulation, are alike indispensable to every large survey. When observing in this chapter that during the progress of field work vertical angles are often taken in the manner already alluded to, it is laid down as a rule that such angles are always to be measured by an instrument having a full or complete vertical circle, so that the double altitude or double zenith distance may be obtained by reversal. The practical gist of this statement resolves itself into a caution to young engineers not to invest their money in the old-fashioned cradle theodolite, which is fitted with only a semicircular vertical arc, and is not yet quite out of date, although all but superseded by the more modern transit pattern. Six tables are added at the end of the volume, and the use and explanation of them is given in Chapter XI.

Beyond mentioning that photographs of the portions of the horizon, where it seems probable that stations may be placed, should be taken, the author makes no further allusion to the application of that wonderful process to the purposes of surveying. We may, therefore, be excused if we very briefly refer to the recently great and highly useful progress it has made in that direction. The title of "Photogrammetry" has been bestowed upon the art, which enables plans, sections, and exact topographical measurements to be obtained by means of photographs. During an extensive survey carried out in the Tyrol three years ago, for the purpose of investigating the action of glaciers, the position of 2000 points was ascertained by means of photography. The points thus fixed were at an altitude varying from 7200ft. to 12,800ft. above sea level, and a plan of them was plotted to a scale of 1/10000 in which separate contour lines 32ft. apart were delineated. About the same period some noticeable photographic surveys were successfully undertaken in our Dominion of Canada. This method was previously adopted some ten years ago in the survey of the principal chain of the Rocky Mountains, and over 200 square miles were completed in one year. The results of a future survey embracing about 450 square miles were plotted to a scale of 1/20000, and subsequently reduced to half that scale for publication. Mr. Merriman's volume is a valuable textbook upon what he appropriately designates as "precise surveying," which may be understood to include all those descriptions of surveys in which time or rate of progress is entirely subordinate to considerations of minute accuracy and precision.

SHORT NOTICES.

Electric Bells and Alarms. A Practical Handbook on their Construction, Installation, and Repair. By F. E. Powell. London: Dawbarn and Ward, Limited. Price 6d. net.—This is a practical little treatise on electric bells. It is well illustrated and clearly written, and will, we think, appeal not only to the amateur who delights in fitting his own, and meddling with other people's bells, but also to the professional bellfitter, who will be glad to have a handy source of information.

The Principles and Practice of the Valuation of Gas, Electricity, and Waterworks for Assessment Purposes. By Thomas Newbigging,

M.I.C.E., and William Newbigging, Assoc. M.I.C.E. Second edition. London: Walter King, Office of the *Journal of Gas-lighting*. 1899. Price 5s.—The first edition of this useful little volume appeared in 1891. The present edition has been revised and extended by the addition of recent judgments delivered by the superior courts. The rating of water and electricity works is now included.

Tables of Squares: Containing the true Square of every Foot and Fraction thereof from 0 to 100ft., advancing by one-sixteenth of an inch. By John L. Hall. New York: The Engineering News Publishing Company.—This is a very comprehensive table of squares. It commences with fractions of a foot, and concludes with the square of 100ft., rising by sixteenths of an inch. The paging corresponds with the tables, so that the place required is readily found. The system of tabulation is good, and as the book is quite small and thin, it ought to find favour with those who use tables of square feet.

BOOKS RECEIVED.

La Télégraphie sans fils. Par André Broca. Paris: Gauthier-Villars. 1899. Price 3f. 50c.

Heat for advanced Students. By Edwin Edser. London: Macmillan and Co., Limited. 1899. Price 4s. 6d.

The Elements of Physics for use in High Schools. By Henry Crew, Ph.D. London: Macmillan and Co., Limited. 1899. Price 6s.

A Text-book of Physics. By W. Watson, A.R.C.S., B.Sc. (London). London: Longmans, Green, and Co. 1899. Price 10s. 6d.

Transactions of the Institution of Naval Architects. Vol. xli. Edited by George Holmes. 1899. London: Office, 5, Adelphi-terrace, W.C.

Handbook of Optics for Students of Ophthalmology. By William Norwood Suter, B.A., M.D. London: Macmillan and Co., Ltd. 1899. Price 5s.

Analyse Chimique Qualitative. Par M. E. Puzzi-Escot, Encyclopédie Scientifique des Aide Mémoire. Paris: Gauthier-Villars, Quai des Grands-Augustins, 55.

The Construction of Roads and Streets, with Historical Sketch of the Development of the Art of Road-making. By W. H. Maxwell, C.E., with numerous specially prepared illustrations. London: The St. Bride's Press, Limited. 1899. Price 3s. 6d.

Practical Plane and Solid Geometry for advanced Students. Adapted to the Requirements of the Advanced Stage of the South Kensington Syllabus. By Joseph Harrison and G. A. Baxandall. London: Macmillan and Co., Limited. 1899. Price 4s. 6d.

The Chemical Trade Journal of Chemical Manufacturers, Merchants, Agents, and Brokers, Assayers, and Analysts, and Makers of Chemical Plant and Materials in Great Britain and Ireland. 1899. Manchester: Davis Bros., 32, Blackfriars-street.

Report to the Hon. Samuel H. Ashbridge, Mayor of the City of Philadelphia, on the Extension and Improvement of the Water Supply of the City of Philadelphia. By Rudolph Hering, Joseph M. Wilson, Samuel M. Gray, Commissioners, Philadelphia. 1899.

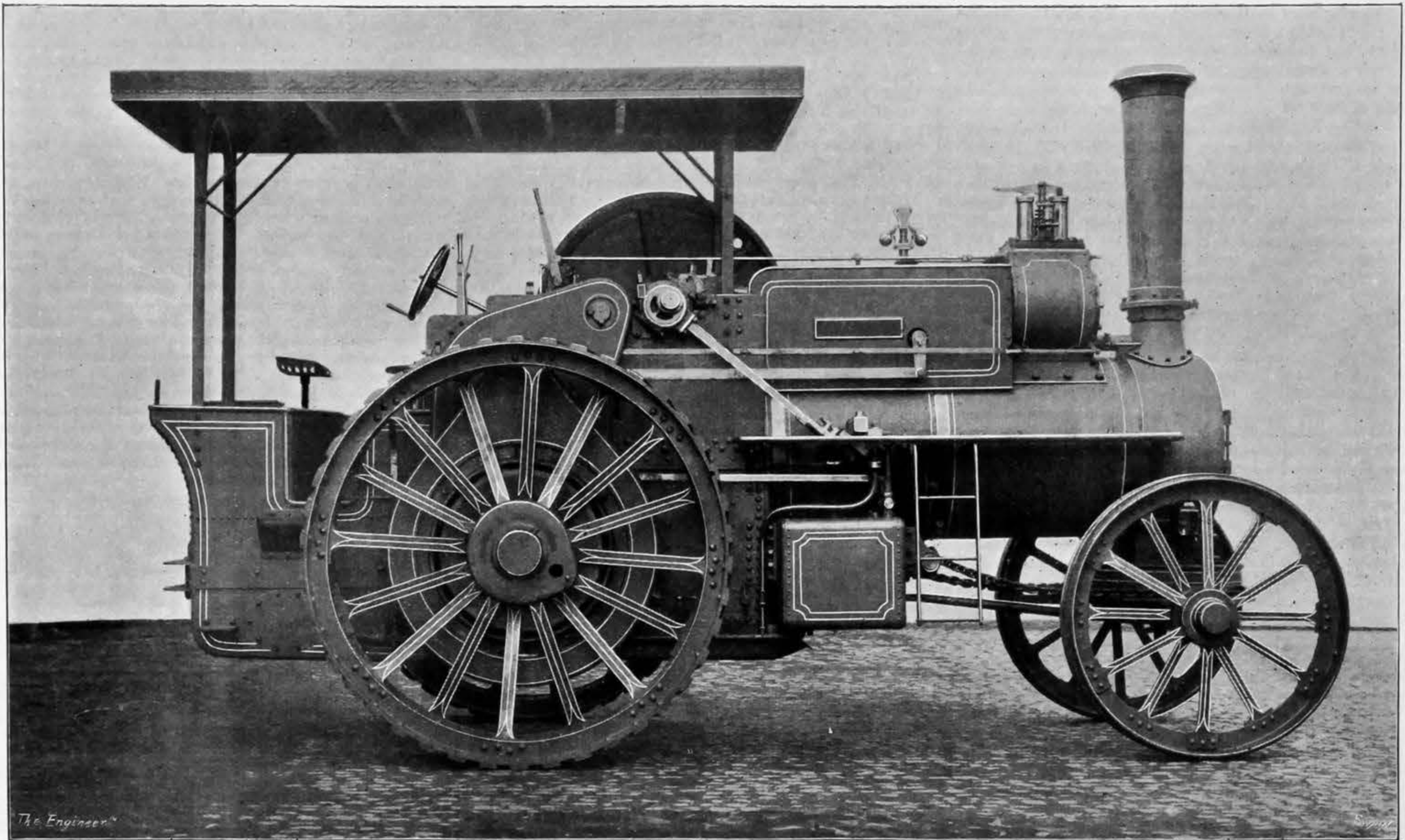
THE INSTITUTION OF CIVIL ENGINEERS.—The meetings of this Institution will be resumed on Tuesday, November 7th, at eight p.m., when the president, Sir Douglas Fox, will deliver an address, and after the presentation of the medals awarded by the Council, will hold a reception in the library.

PROFESSOR RIEDLER AND THE CHARLOTTENBURG CENTENARY.—On the occasion of the centenary of the Technical High School at Charlottenburg, the Rector, Professor Riedler, being desirous of marking the event by some durable memorial, had prepared a review of the growth and development of the high-speed motor in connection with those applications with which he has been more particularly associated, namely, pumping engines, air compressors, and blowing engines, the examples being selected over a very wide range both in Europe and America. This, however, has gone so far beyond the dimensions originally planned as to have developed into a volume which, under ordinary conditions, could only be sold at a price beyond the reach of many at least of the younger members of the profession whom the author wishes especially to reach. He has, therefore, determined to bear the whole cost of the production himself, and to present the work to the Verein Deutscher Ingenieure, subject to the conditions that it be sold at a moderate price, and that the whole of the receipts be applied to the Hilfskasse of the Society, a fund which is similar to the benevolent fund of the Institution of Civil Engineers. These conditions having been accepted, the work will shortly be obtainable from Mr. Julius Springer, 3, Monbijou Platz, Berlin, N., at the price of 12 marks per copy. The title is "Schnellbetrieb," and from the table of contents circulated with the notice, we gather that it is a volume of 533 quarto pages, with about 1300 illustrations and diagrams, and includes notices of the newer developments in the class of engines treated, including a final study of the blowing engine driven directly by blast furnace gas. As the offer is not restricted to members of the Society, we reproduce the above information from our contemporary the *Zeitschrift des Vereines Deutscher Ingenieure*, as likely to be of interest to many of our readers.

YORKSHIRE COLLEGE ENGINEERING SOCIETY.—"Workshop Training with Technical Education" was the subject of the opening lecture of the session in the engineering department of the Yorkshire College, by Mr. Wilson Hartnell, M.I.M.E., Mr. H. McLaren in the chair. The lecturer urged that workshop training—often misunderstood by students—was necessary to the engineer in order to fit him to take any useful position in engineering works. Students had from time to time applied to him for places, but as they had had no workshop training he was compelled to say they would not suit. The manager of a large works employed in one instance a draughtsman who had had technical instruction but no practical experience, and that man proved a great disappointment—he was of little service. A man might have won a Whitworth Scholarship and yet, without practical experience in the workshop, be of no use whatever. Scientific conceptions were, he said, abstract, unreal, and necessarily omitted many things; but in dealing with realities every fact must be carefully weighed, and have its due place. Mental qualities which made the student were not necessarily the mental qualities which made the successful man in dealing with his fellow-men. The lecturer suggested that every student who wished to advance in engineering and who took up the profession should be in the position of an employé. He enlarged on and emphasized the value of workshop experience, pointing out in detail how the student without that experience would be at a disadvantage. Persons without that experience were, to his mind, utterly unfitted for positions of trust and responsibility, whereas the possession of it gave a man an insight into the relations between ruler and ruled, into questions of discipline and organisation, and into details of management on which the success of an establishment depended. Experience of that kind familiarised a man with hand work, tool work, and the erection of machinery in the works and outside. At the same time, there were advantages in a scientific training of the mind—those of close observation, correct and logical thinking, and the drawing of conclusions, all this leading to self-confidence. Workshop experience he, however, looked upon as a *sine quâ non* if success as an engineer would be attained. The student ought to have curiosity, but a trained curiosity, or he would get into trouble, and he should be careful not to have too much modesty. The advantage of a college education he fully admitted. Mr. Wilson Hartnell was warmly thanked for his lecture. About thirty new members were admitted.

SINGLE CYLINDER ROAD LOCOMOTIVE

CLAYTON AND SHUTTLEWORTH, LINCOLN, ENGINEERS



SINGLE-CYLINDER ROAD LOCOMOTIVE.

OUR illustration shows a new type of road locomotive which has just been constructed by Clayton and Shuttleworth, of Lincoln. We recently had an opportunity of inspecting this locomotive just as it had returned from a somewhat severe road test. This was the hauling of a load of thirty tons, made up of a 25-horse portable engine filled with water, and a trolley loaded with pig iron, up Canwick Hill, near Lincoln. This hill, as many of our readers will be aware, is long, and for a good stretch the gradient is as much as 1 in 9. We are informed that the test was in every way successful, as also had been the brake trials and fast-gear runs over uneven ground.

The locomotive has been built to do long journeys, and appears to be very strongly constructed. In addition to the ordinary water tank at the rear of the engine, there is also a second tank fitted beneath the boiler barrel. These two tanks are connected together by means of a pipe, in which is a cock worked from the driving platform, which prevents waste of water when the engine is mounting heavy gradients. The water carried is sufficient for a run of ten miles and over with full load. There is a footboard running the full length of the boiler barrel which allows the driver to have access to all moving parts without dismounting. There are two speeds, the "fast" being four to five miles an hour, and the "slow" two to three miles an hour. The driving wheels are 6ft. 6in. in diameter, and have a width of 1ft. 6in. The working pressure is 150lb., the cylinder is 9in. in diameter and 12in. stroke, and the fly-wheel is 4ft. 6in. in diameter. The fire-box is of the ordinary locomotive type for burning coal.

EARLY CENTRAL BUFFER SYSTEMS.

At the present time, when there is much incoherent talk about the supposed inefficiency of our time-honoured system of side buffers, and when the merits of everything American are so loudly proclaimed, it may be of interest to recapitulate the brief history of central buffers in this country.

Apparently the first passenger line which completely fitted its rolling stock with central buffers was the Dublin and Kingstown. Very little experience existed as to the effects of different modes of coupling or buffing. The Liverpool and Manchester Railway had by no means devised a satisfactory system during the four and a-quarter years the line had been at work. The Dublin and Kingstown, opened December 17th, 1834, must have been little better off at first, for though buffers of some kind seem to have been applied, they were so deficient in elasticity that many passengers had their heads knocked together during the opening runs on that day. A Dublin correspondent of that time naïvely reported that "a few broken heads do not throw much damp on a scene of Irish amusement where everything else goes well." However, it was found that the violent bumping at every stoppage would not do, and the company's secretary, Mr. Thomas F. Bergin, promptly devised and applied to the whole stock a system of "through buffing." As the name implies, the buffer rod went through the vehicle in a welded iron tube $\frac{1}{2}$ in. thick and 3in. in diameter, and projected 2ft. at each end. To allow for the different levels of adjoining coaches, as they were full or empty, the aperture in the headstock was 3in. wide by 9in. deep. Upon the ends of the rod were large leather pads stuffed with some resilient material, and behind these a yoke of iron, sliding freely on the rod, and a little larger than the diameter of the buffer head. Chains and hooks being applied at each end of the yokes, the latter were drawn close to the buffer heads when these were in con-

tact, and locked up as closely as could be managed. Upon the tube was coiled, for 4ft. within each end of the vehicle, a strong spring, confined between a collar formed upon the tube nearly over the axle, and a small box with friction rollers placed just inside the headstock. About under the centre of the coach were other friction rollers, the tube being able to slide in and out under the vehicle to the extent of 2ft. It is evident that a concussion would drive the buffer tube and rod inwards, compressing the spring against the roller box at the opposite end, such spring restoring the tube to its normal position when the pressure was taken off. The apparatus was found to answer very well with the light weights and slow speeds used on the line, the trains running with great steadiness. The first cost of the system was estimated at £50 or £60 less per vehicle than the side buffers and transverse springs then used—but without screw couplings—on the Liverpool and Manchester Railway.

It was Booth's invention of the screw coupling which saved the reputation of side buffers, and, in fact, it seems to have been applied later on to screw up the yoke couplings of Bergin's apparatus. An excellent drawing of the latter, representing a Dublin and Kingstown second-class coach, is to be found in the specification of Bergin's patent, No. 6781, May 4th, 1835. So far as we know, his buffers continued in use till the line was widened to the Irish gauge of 5ft. 3in., about the year 1858.

On the same line of railway another form of central buffer was tried early in 1836, though the inventor seems only to have used a central one to work in with Bergin's, and not from any conviction of its superiority over side buffers. One of the open ten-seated third-class coaches was fitted with Mallet's "hydro-pneumatic" buffer. A cast iron cylinder, 6in. in diameter, and about as long as the wheel base, was fixed below the vehicle, and was traversed by a strong continuous buffer rod of iron, $2\frac{1}{4}$ in. thick. This rod carried a solid piston packed with leather collars, which under normal conditions was in the centre of the cylinder, there being stuffing-boxes, of course, at each end. Cast upon the ends of the cylinder were two upright domes or air vessels, which projected under the seats. The horizontal cylinder was filled with water on each side of the piston through a screw plug, but the domes contained air forced in at about 15lb. pressure per square inch. When the buffer rod was driven in by a blow, it, of course, compressed the air and water at the furthest end of the cylinder, and reduced the pressure in the other end by giving the air room to expand, whilst the highly-compressed air would bring the piston back to the central point where the pressure on each side would be equal. Here again the buffer rod had 2ft. play, and projected considerably beyond the end frames. There were stops or counter heads upon the rod to prevent its being driven so far into the cylinder that the piston would strike the cover, but it is pretty evident that the stop would break and displace the cylinder if it reached it. In practice it was found that the recoil of the buffer was much too slow, the friction of the piston being so great that it would not return to the centre of the cylinder by some inches. The apparatus when full weighed about $9\frac{1}{2}$ cwt., which is, of course, a great deal for a vehicle of perhaps five tons, and in consequence of its general clumsiness and inefficiency was seldom used, and never extended to any more of the stock. Mr. Mallet also designed a station buffer on the same principle, of most imposing dimensions, the plunger being 3ft. in diameter, with a stroke of $3\frac{3}{4}$ ft., but it does not appear that it was ever erected.

A train of low-hung coaches, devised by Mr. W. J. Curtis, manager of the locomotive department of that line, was put in service on the Greenwich Railway, when only a small portion of it was open, in the summer of 1836. The leading

coach had a central buffer, a draught spring being fitted to the engine and the two connected by an iron rod, or pin-and-eye arrangement. The other vehicles were also connected by bars, but the rear vehicle must also have had a central buffer for use on the return journey. Most of the stock, if not all, was either built on or altered to Curtis's system, in which the soles were placed below the axles, and but a very few inches above the rails, the idea being that one sole would bear on the rails if the coach got off and so act as a brake or drag. Drawings of these extraordinary carriages may be found in the *Mechanics' Magazine* for July 2nd, 1836.

The Norris bogie single-driver engines, sent from Philadelphia to the Birmingham and Gloucester Railway in 1840, had at first central buffers between engine and tender, but being soon converted into tanks, the arrangement was discarded, the company using Booth's screw coupling and side buffers for all its stock.

On December 28th, 1840, Mr. W. B. Adams procured a patent, No. 8756, which included amongst other matters the use of elliptical springs placed between a detached buffer beam and the headstock. The draw-bar came through the centre of the spring or springs, for one or two, as preferred, could be used, set with either their convex or concave surfaces towards each other. There were two buffer heads, but they acted, of course, like one central buffer. Vertical springs could be used, but it was proposed to have them transversely. Mr. Adams denominated them "shifting fulcrum springs," and seems to have had some measure of success in introducing them, for it was reported in 1842 that the Hamburg and Bergedorf line used them, and that 73 sets of double-buffer springs, and 50 sets of single ones, on Adams' principle, had been supplied to different railways. The South-Eastern Railway, then only open from Redhill to Tunbridge, was said to have 25 of its 72 coaches fitted with them.

Several of the Midland express engines were provided with central buffers to the tenders to work the Pullman cars on their introduction by the late Sir James Allport in 1874, but both cars and tenders were soon altered to side buffers. The close-coupled suburban trains on the Brighton Railway, used since about the same date, may perhaps be considered examples of central buffing, although the head and tail of the train have ordinary side buffers, and the wooden blocks between the coaches have no springs or buffing medium to take up shocks of impact.

AMERICAN ENTERPRISE FOR BRAZIL.—An American and Canadian company is preparing to build a dam and power station to develop the power of the Parnabyba Falls of the Tiete River, 23 miles above the city of Sao Paulo, in Brazil. The fall is 60ft., in a series of rapids $1\frac{1}{2}$ miles long. The company will also operate electric tramways, and an electric-lighting plant. The flow is 280,540 cubic feet per minute, developing 25,500-horse power, with an allowance of 80 per cent. efficiency for the turbines. The plant will develop 15,000 to 20,000-horse power. At present the company has a steam power station, with Robb engines, two General electric dynamos of 225 kilowatts capacity, and Cahall water-tube boilers. This plant now supplies 5000 commercial incandescent lamps. All the work and machinery will be planned and supplied by Americans. The tramway track is of the Pennsylvania Steel Company's 7in. 90lb. girder rails, laid on concrete, with steel sleepers at intervals of 10ft. For suburban lines, 62lb. flange rails will be used. The Riter and Conley Company will build 25 miles of 8ft. and 12ft. steel pipe from the dam to the power station, the pipe being of $\frac{3}{4}$ in. and $\frac{1}{2}$ in. steel plates. This company will also build the steel-framed power station, car house, &c. The turbines will be of the Stilwell-Bierce pattern, and will cost £100,000, with the necessary equipment and appliances. The tramway will be equipped with the Brill Company's cars, similar to those now in use on the New York lines.

ELECTRIC TRAMWAYS AND LIGHT RAILWAYS IN LONDON.

As may perhaps be remembered, the London County Council decided in July last to make application to the Board of Trade for a Provisional Order to authorise the construction of new tramways and the doubling of certain existing single lines in the metropolis, the total expenditure involved being estimated at approximately £640,000. Since then the Council has varied its proposal to the extent of leaving the Tramways Act alone, and resolving to promote a special Bill purposely for the tramways, and also with a view of obtaining powers to carry out the widening of various thoroughfares affected by the schemes for laying down double tracks. It is hoped by this means to obviate the necessity for depositing more than one set of plans, and at the same time to effect economy in other directions; but it is possible that there is a more important reason underlying the change of procedure, especially when it is borne in mind that under the Tramways Act the consent of the road authorities is necessary, whereas in the present case such permission might not be essential before a parliamentary committee. Of the tramways affected by the proposed Bill only two are intended to be worked by electric traction. The first is a new line from Rushey Green to the Crystal Palace, of a total length of 3½ miles; and the second refers to the existing tramway between Camberwell and the terminus at Vauxhall, which will be made double throughout for the purpose of the new system. It is intended to equip these two lines on the underground conduit principle, in a manner similar to that already decided upon in the case of the Westminster Bridge-Tooting tramway, although a portion of the latter will also be laid for the purpose of affording a trial of some form of surface contact system. It will thus be seen that in so far as tramways are concerned—or rather that appears to be the opinion of the London County Council—there are only three tramways which it is proposed to construct according to some method of electrical working. But a new light is thrown upon the question when we consider the Council's attitude in relation to what it is pleased to term "light railway" schemes.

It is certainly something new to find the idea seriously entertained that the Light Railways Act can be made to apply to the metropolis, and that it may be possible under the Act to construct extensions of the tramways in the suburbs as light railways to be operated by electric traction. Yet this opinion is held by a majority of the members of the London County Council, which has just resolved to apply to the Light Railway Commissioners for an order to construct three light railways on the south of the Thames and one on the northern side of the river. What the Commissioners will say in regard to these schemes must be left for the future to decide, but with the precedent established in the case of the Corporation of London and the projected line to the Deptford cattle market, and that decided at Taunton, it is not an easy matter to understand how light railways can receive the approval of the Light Railway Commissioners or even the confirmation of the Board of Trade at a subsequent period. No difficulty, however, exists in arriving at the conclusion that by proceeding under the Light Railways Act the London County Council is endeavouring to avoid the obligations and responsibilities of the Tramways Act, and at the same time supersede the powers of the Vestries and District Boards as the road authorities, as in the case of the new tramways referred to at the beginning of this article.

Leaving to the Board of Trade for final decision the question of light railway or tramway, it should be mentioned that the construction of the four light railways is estimated to cost £635,000, and two of these are proposed to be equipped on the overhead trolley system, according to the advice of Prof. A. B. W. Kennedy and Mr. Baker, the manager of the County Council Tramways. This is a remarkable departure to make, since, with the exception of two short sections of the London United Tramways, the Council has firmly refused to sanction the overhead system in any part of London. The first projected trolley line is to run from the tramway terminus near the Archway Tavern, Archway-road, Islington, to the county boundary. It will only be about three furlongs in length, but it will connect together the lines leased to the North Metropolitan Tramways Company and the light railways proposed in Middlesex. The second trolley line will be constructed from West Hill, Wandsworth, via Kingston-lane, to the county boundary, this forming one-half of the second light railway, which is to commence at Clapham Common, south side, and proceed by way of Battersea Rise to West Hill; the total length will be five miles three furlongs. The other two light railways, which are to be worked according to some form of underground electric traction, will be about ten miles long, between New Cross and Eltham, and between Shooter's Hill and Woolwich respectively. The services of Prof. Kennedy, both in the case of the tramways and the so-called light railways, have been requisitioned to devise and supervise the electrical and other details of the lines.

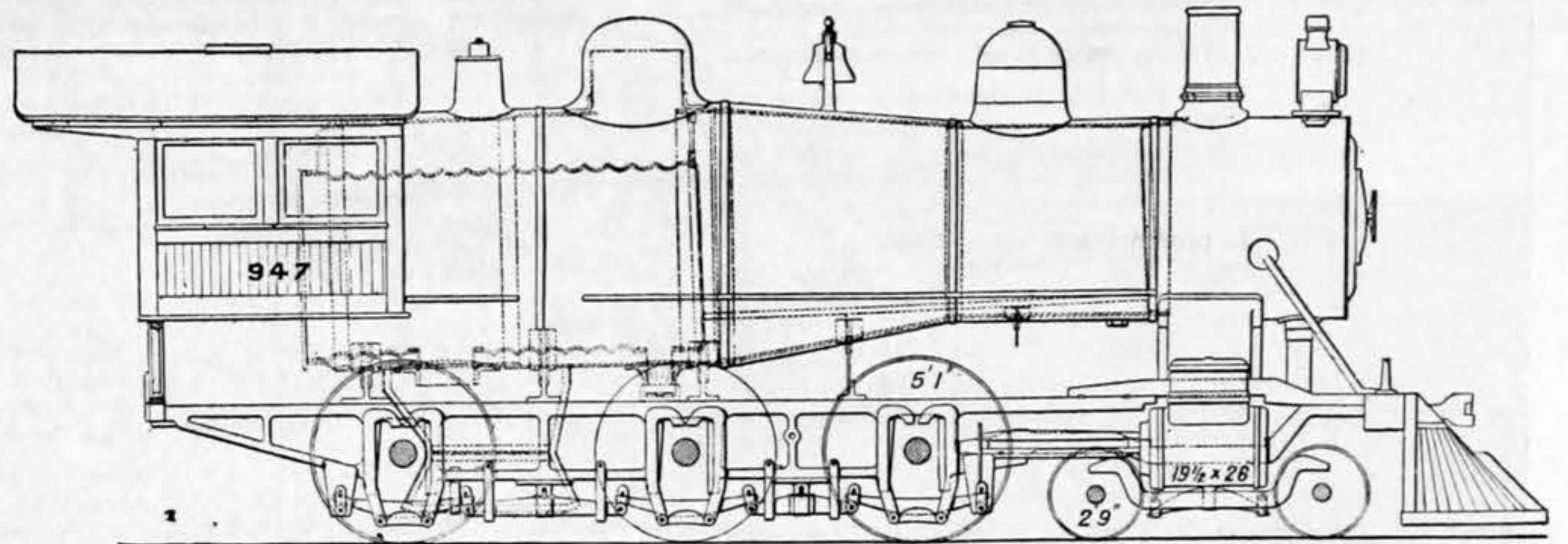
NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet engineers: William W. White, to the Juno, on commissioning; Thomas Wheby, to the Vivid, additional for the Cleopatra. Staff engineers: William J. Black, to the St. George; Joseph H. Pill, to the Minerva, both on commissioning; Edward G. P. Moffett, to the Pembroke, additional for the Champion, all to date October 31st. Chief engineer: George C. Bath, to the Cambrian. Engineers: Samuel P. Ferguson, to the Juno; Thomas Shattock, to the Cambrian; Alfred E. Everitt, to the St. George; Charles J. Gregg, to the Minerva, all when commissioned, and all to date October 31st; Frederick C. Davis, to the Duke of Wellington, additional, to be detailed for duty in the Brazen, to date October 25th; William McGregor, to the Terror, additional for charge of torpedo boats and torpedo sub-depot, to date October 19th; George W. Murray, to the Duke of Wellington, additional for the Hornet, undated; Harry T. Garwood, to the Terror, additional for the Rocket, in lieu of chief engineer; George G. Knight, to the Duke of Wellington, additional for the Spiteful, in lieu of chief engineer.

THE VANDERBILT CIRCULAR FIRE-BOX, NEW YORK CENTRAL RAILROAD, U.S.A.

ATTEMPTS have been made at various times to simplify the construction and increase the efficiency of locomotive boilers, by the use of a cylindrical fire-box instead of the ordinary rectangular fire-box, whose flat surfaces require so much staying, involving a great amount of labour and time in construction and repairs. For various reasons, however, only partial success has attended the experiments, and the system has never yet got beyond the experimental stage.

One of the latest and most promising attempts of this kind has recently been made in the United States. A goods engine of the New York Central Railroad has been fitted with a boiler of somewhat peculiar design, the special feature of which is a corrugated cylindrical fire-box, like the furnace of a marine boiler, and having a clear inside diameter of 4ft. 11in. The boiler was designed by Mr. C. Vanderbilt, jun., one of the assistants to Mr. A. M. Waitt, the locomotive superintendent.

The boiler is 29ft. 3in. long over all. The smoke-box is 5ft. 7in. diameter and 5ft. 6in. long, and the first barrel course is 5ft. 4in. outside diameter, and 6ft. 3in. in length. This course has plates ¼in. thick, and fits telescopically into the smoke-box and into the second barrel course. Within it, near the front end, is riveted the flanged tube sheet, which is slightly inclined backward from the vertical, as the boiler is inclined forward in order to clear the driving wheels. The second barrel course is conical, 5ft. 4in. diameter at the smaller end and 7ft. at the rear, its length being 6ft. 6in. The outer fire-box shell is circular, 11ft. 3in. long and 7ft. 1½in. diameter, built up of two courses in length. The boiler is thus of circular section from end to end. The corrugated fire-box is 4ft. 11in. inside diameter, and 5ft. 4in.



LOCOMOTIVE WITH CORRUGATED FIRE-BOX

diameter at the ends, while its total length is 11ft. 2½in. It is of ¾in. steel. In the front is a flanged tube sheet, while the rear end projects through the boiler head, and is riveted to the flanged back plate of the outer fire-box shell. The only fire-box stays required are twenty-eight sling stays, arranged in a circle around the front end of the fire-box, these being 1½in. diameter, with forked ends fitting over T-bar studs.

The dome, 30in. diameter and 20½in. high, is directly over the front end of the fire-box. At the back part of the bottom of the fire-box is an 18in. opening to the ashpan, while at the front end, beyond the brick bridge wall, is an 8in. opening for cleaning out such ashes as may collect in this combustion chamber between the bridge and the tube sheet. The fire-box is, of course, not concentric with the boiler, the steam space above the fire-box being 1ft. 6in. high, while the water space decrease from 11in. at the sides to 3½in. at the bottom. There are two oval fire-doors, 16in. by 13in., side by side, as in some of the wide Wootton fire-boxes, for burning small coal of poor quality.

The longitudinal stays for the boiler are shown by dotted lines. In the boiler are 332 tubes, 2in. diameter and 12ft. 6in. long. They are set in vertical rows, staggered horizontally, and are spaced 2¼in. centre to centre.

The engine was built in the shops of the railway company, and is of the six-coupled bogie type, known in America as the "ten-wheel" type. It has six coupled driving wheels, of which the middle pair are the main drivers, while under the smoke-box is a four-wheeled leading bogie. The leading dimensions are as follows:—

Cylinders	20in. by 23in.
Driving wheels .. .	5ft. 1in.
Bogie wheels .. .	2ft. 9in.
Driving journals .. .	9in. by 12in.
Boiler, diameter of barrel .. .	5ft. 4in. to 7ft.
Fire box shell, diameter .. .	7ft. 1½in.
Fire-box, diameter inside .. .	4ft. 11in.
Fire-box proper, length .. .	8ft. 2in.
Fire-box and combustion chamber, length .. .	11ft. 2½in.
Steam pressure .. .	185 lb.
Tubes, 332, diameter .. .	2in.
Tubes, length .. .	12ft. 6in.
Heating surface, tubes .. .	2165 square feet.
Heating surface, fire-box .. .	192 square feet.
Heating surface, total .. .	2357 square feet.
Grate area .. .	34 square feet.
Weight, on driving wheels .. .	113,800 lb.
Weight, on bogie .. .	46,700 lb.
Weight, total tons, English .. .	71.5

The boiler steams so freely, or, in other words, generates steam so rapidly, that the two 3in. safety valves were found not to afford sufficient relief, the pressure several times running up to 195 lb. when the valves were set to blow off at 180 lb. A third valve has since been added. The engine made a trip of 143 miles on its first run, with a train of fifty wagons, and after a stop of three hours returned with a train of sixty-seven empty cars—about 800 to 900 tons. It attained a speed of 25 to 30 miles per hour on this trip, and it was noted that very few cinders were thrown from the smoke-stack or funnel.

The use of corrugated fire-boxes in locomotives is by no means new. They were invented by the late John Haswell, of Vienna, about the year 1870, or possibly earlier. They were in use on the Austrian Staates Bahn for many years. Probably most of our readers who are interested in locomotive design will recall the corrugated flue furnaces used in Mr. Strong's singular locomotive, which was tried about ten years ago in the United States, and was described in THE ENGINEER at that time. Mr. Strong, however, used two furnaces, side by side, with their ends connected to a third corrugated flue, which formed a combustion chamber, and at the end of which was the tube sheet. This arrangement was specially designed for very long runs, and for

inferior fuel, the fires being cleaned and fed alternately. The engine made trips of 440 miles with one train, but it required two firemen to keep the fires in condition. The three corrugated flues were 38½in. diameter, with a 5ft. boiler barrel, and a fire-box shell, 5ft. by 9ft. The furnaces were 9ft. 6in. long, the distance from boiler head to tube sheet being 18ft. 6in. The tubes were 11ft. 6in. long, and the total length of boiler, from the back plate of the fire-box to the front of the smoke-box, was 33ft. This type of boiler is evidently only adapted to engines of special design.

In 1890 Mr. Gustav Lentz, formerly managing director of the Hohenzollern Locomotive Works, in Germany, designed a locomotive boiler, having a corrugated cylindrical furnace. His boiler was of larger diameter at the middle than at the ends, and the rear part of the furnace was inclined downwards. This part formed the furnace proper, a brick wall with a semicircular opening being built at the end, and the horizontal portion of the furnace forming a combustion chamber. A six-coupled goods engine, with cylinders 17½in. by 24½in., and wheels 4ft. 4½in. diameter, was fitted with a Lentz boiler, the weight of the engine being about 32½ tons. The furnace was 3ft. 9in. diameter, with 6ft. of its length as a fire-box, and 4ft 11in. as a combustion chamber. The tubes were only 10ft. long. In 1892 a four-coupled bogie express engine, for the Prussian State Railways, was built according to the designs of Mr. Lentz. It had cylinders 17in. by 23½in., driving wheels 6½ft. diameter, and weighed 50 tons. This engine is said to have been successful as a steam generator, and for complete combustion of fuel, but was very wasteful of the heat. The smoke-box temperature, in fact, reached 768 deg., while in the ordinary engines it was about 526 deg.

The Vanderbilt boiler is of much simpler design and easier of construction than either the Strong or the Lentz boilers, and it appears to promise good results in service. Whether

it will effect any practical change or revolution in locomotive design remains to be seen. At present the one goods engine is in regular service, and a record is being kept of its performance. The general results of one of the trips with a goods train were as follows:—

Distance .. .	140 miles.
Total time .. .	8 hours 15 min.
Running time .. .	6 hours 51 min.
Speed, average for running time .. .	20.4 miles per hour.
Speed, maximum .. .	30.2 miles per hour.
Weight of train, behind tender—gross tons, 2240 lb .. .	823 tons.
Weight of train, engine and tender—gross tons, 2240 lb .. .	940 tons.
Coal consumed .. .	12,390 lb.
Water consumed .. .	107,571 lb.
Water evaporated, per pound of coal .. .	8.60 lb.
Water evaporated from and at 212 deg. Fah. .. .	10.30 lb.
Coal per car per mile .. .	1.43 lb.
Coal per 100 tons per mile .. .	9.40 lb.
Tons hauled one mile per pound of coal .. .	10.40 tons.
Tons hauled one mile per pound of water .. .	1.23 tons.

THE S.S. AMERICA MARU.

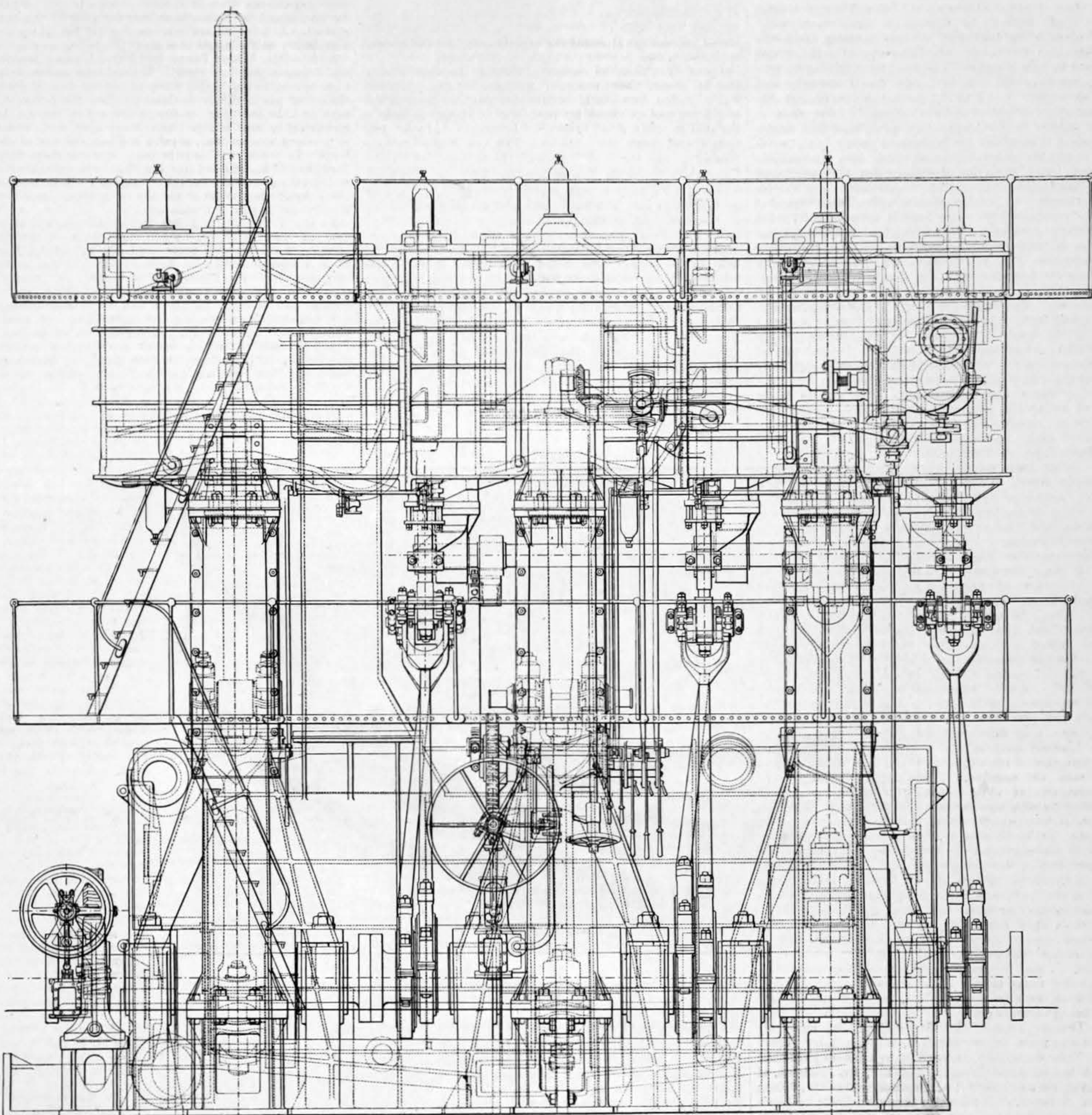
THE propelling machinery of the America Maru, a vessel of which we gave a general description last week, consists of two sets of independent triple expansion engines, having cylinders 28½in., 46in., and 75in., with 48in. stroke; steam at 180 lb. pressure being supplied by five multitubular natural draught boilers, four of which are double-ended and one single-ended. The engines, boilers, and accessories were built and installed, as already stated, by the Wallsend Slipway and Engineering Company, Limited, and through the courtesy of this company we are enabled to illustrate the engines herewith and on page 417. From the cuts showing front elevation and end elevation of one set of engines it will be gathered that the cylinders are secured in such a way that they form one whole, supported by six box-shaped cast iron columns, rising from a cast iron bed-plate made in two pieces in the form of hollow girder section. The cylinders of each set of engines are tied transversely by two cast iron girders; one between the high-pressure cylinders and one in wake of low-pressure cylinders. The high pressure cylinder of each set is fitted with a piston valve on the outside of the cylinder, and the intermediate and low-pressure cylinders have their chests between the high-pressure and intermediate, and the intermediate and low-pressure respectively. As will be noticed, the use of a steam belt around the cylinders permits of the huge copper piping so often used for carrying steam from one cylinder to another to be entirely done away with. The intermediate and low-pressure valves are flat-faced double-ported slide valves, and are worked by the ordinary double eccentric and link motion valve gear. The reversing gear for each set of engines is of the all-round type, with worm and wheel gearing, placed in the front middle column on which all the steam throttle and drain cock levers are fixed, giving great facility for manipulation. The weigh-bar shafts are placed at the back of engines, carried on bearing brackets attached to the cylinder bottoms, thus leaving the front of the engines clear. The surface condenser rests on the engine seating and is attached to the engine bed-plate, forming, in fact, one side of it.

The crank shafts are of wrought iron, in three interchangeable pieces, the crank pins being of ingot steel. The main bearings are of cast iron lined with white bronze. The propellers are loose-bladed, of manganese bronze, supplied by Billington and Newton, the blades being attached to a cast iron boss by Lowmoor iron studs and brass nuts.

The total cooling surface in the condenser of each set of

ENGINES OF THE S.S. AMERICA MARU—FRONT ELEVATION

THE WALLSEND SLIPWAY AND ENGINEERING COMPANY, LIMITED, ENGINEERS



SEAN ENG

"THE ENGINEER"

engines is about 8500 square feet, and the injection water is supplied by a 15in. centrifugal pump, having a 34in. gun-metal disc, driven by a separate engine of W. H. Allen, Son, and Co.'s make, having a 9in. cylinder with a 7in. stroke. There is one air pump to each engine, 26in. diameter and 26in. stroke, attached to the condenser and worked by levers from the intermediate rod. There are two feed pumps actuated by each set of engines, these being 4in. diameter by 26in. stroke, delivering into a Weir direct contact feed-heater, or direct into boilers as desired; the feed from the heater being delivered to the boilers by a Weir pump. The whole of the feed-water passes through a Harris feed filter of large size.

There are also in the engine-room two 20-ton evaporators, of G. and J. Weir's make, for supplementary feed, these being so fitted and arranged that one can be cleaned while the other is in use. In addition there are two Worthington horizontal pumps for auxiliary feed and for fire and sanitary purposes, a fire service pipe being fitted throughout the ship in accordance with the American law. For discharging water ballast there is a Worthington horizontal ballast pump of large size, capable of discharging ballast at the rate of 200 tons per hour. The pumps for feed and fire service are ranged across the ship at the fore end of the engine-room, the starting platforms being between the two sets of engines. This arrangement brings all the working parts of engines and the greater part of the auxiliary machinery in view when at work, and obviates a congested platform at the back of the engines.

The boilers supplying steam at 180 lb. pressure—four double-ended 15ft. 6in. diameter by 10ft. 6in. long, and one single-ended—have in all twenty-seven furnaces of the Purves ribbed type, the total heating surface of the boilers being about 20,000 square feet. The double-ended boilers are arranged two abreast, with the single-ended boiler forward, making three stokeholds. The single-ended boiler is used for working

auxiliaries in port, or for driving the main engines if required. There are two oval funnels, one to each pair of boilers, and each stokehold is provided with a See's ash ejector, water pressure for working the same being supplied by a vertical duplex donkey pump, made by Clarke, Chapman, and Co., of Gateshead.

The vessel is lighted throughout with electricity, including the masthead and side signal lamps, the generating plant being in duplicate to provide against the contingency of a breakdown. Refrigerating machinery connected with a large cold storage chamber is also fitted, enabling fresh provisions to be served at all times. To cope with the cargo she is designed to carry, the vessel is provided with a full complement of powerful steam winches and other discharging gear.

The machinery and boilers of the American Maru were constructed under special survey of Lloyd's, Board of Trade, and to conform to American law and Japanese Government requirements, and the whole were under the inspection, on behalf of the owners, of Messrs. Flannery, Bagallay, and Johnson, London, whose services were also requisitioned in connection with the construction of the vessel herself.

FRENCH SUBMARINE BOATS.

THE flotilla of submarine boats in France promises to present as great a variety of types as the battleships. After the enthusiasm following upon the performances of the Gustave Zede had simmered down, and people began to look at it from a more practical standpoint, it was recognised that its small range of action was calculated to lessen considerably its utility as a war engine. The new vessel, it was said, had at any rate proved the practicability of the submarine boat, and in the hope of getting something better the naval authorities

gave fresh attention to the somewhat despised Goubet boat. This vessel, however, showed a tendency to dive to the bottom and stay there, and the naval experts begin to pin their faith in boats of the Morse type. Recent trials with the Morse submarine showed that as regards the range of action it had scarcely any advantage over the Gustave Zede, and it had to be admitted that the boat could not be used for any other purpose than harbour defence. After all these experiments, however, it did not seem as if much headway had been made, but the naval department, with praiseworthy optimism conveyed its favours to the Narval, simply because absolutely nothing was known as to the behaviour of this type of vessel, and plenty of scope was consequently allowed for the exercise of a vivid imagination. The Narval has been constructed upon the plans of M. Laubeuf, a naval engineer, who secured the gold medal in the competition for submarine boat projects organised by M. Lockroy. She was put upon the stocks at Cherbourg in July, 1898. Constructed of steel, she has a length of 34 m., a width of 3.75 m., and draws 1.60 m. of water when navigating at the surface. Her displacement is 160 tons. The motive power is supplied by a Forest oil engine, which not only drives the propeller when the boat is either navigating at the surface or with only her look-out and chimney exposed, but also operates a dynamo for charging batteries of accumulators, these being used to propel the boat when she is entirely submerged and the chimney unshipped. Sailing at the surface at 12 knots, the Narval promises a range of action of 252 miles, and at eight knots the range is to be 624 miles. When submerged the accumulators will propel the boat twenty-five miles at eight knots, and seventy miles at five knots. The Narval is equipped with four torpedo tubes, and carries two officers and nine men. The boat was launched at Cherbourg last week, and the greatest interest is being taken on the other side of the Channel in her forthcoming trials, and it is this type of vessel which carries the hopes of France.

EARLY PADDLE-WHEEL STEAMSHIPS.

No. III.

We give this week a sketch—Fig. 13, page 423—of the Illinois, another fine vessel of the Vanderbilt Line, already referred to in our last impression.

The fine paddle steamers of the Pacific United States Mail Steamship Company have been mentioned already in No. XII. of our articles, and the large steamer China of this line was illustrated and described in THE ENGINEER for April 28th last. We now give a sketch of the Pacific Liners Great Republic and Montana—Figs. 14 and 15—these being two remarkably fine examples of the Pacific Company's large fleet of vessels, which in 1874 amounted to no less than thirty-three ships, twenty-one of which were paddle, and twelve screw steamers, the latter comprising two four-masted new liners, viz., the City of Peking and City of Tokio, built by the Delaware River Iron Shipbuilding and Engine Works, Chester, Pa., John Roach, president. These at the time mentioned were the largest ships of the Pacific fleet. They were each 5500 tons, length 423ft., beam 48ft., depth 38½ft., the City of Peking, of which we give an illustration, Fig. 17, having compound engines with high-pressure cylinders of 51in. diameter, low-pressure cylinders 88in., stroke of piston 54in., indicating 4500 horse-power. The diameter of the Hirsh propeller was 20ft., pitch 30ft., 65 revolutions per minute, giving a speed of 15½ knots. The ship, as also the sister ship City of Tokio, had ten boilers, 10½ft. in length, and of 13ft. diameter, 60 lb. steam pressure. These vessels were built for the San Francisco and China trade.

Besides these two "flag ships," its largest screw liners in 1874, the company at that time owned four more screw steamers of 3000 tons each, one of 2100 tons, two of 1700 tons, one of 1900 tons, and two of 1000 and 700 tons respectively. The paddle liners in the same year comprised the vessels named in table.

As far as we can learn most of these steamers, if not all, were of the overhead beam engine type. The Montana, 2700 tons, had the following chief dimensions:—Length on water-line, 320ft.; breadth of beam, 43ft.; depth of hold, 27ft.; tonnage, 2676; builder's tonnage, 3230; length on spar deck, 340ft.; breadth over all, 72ft.; diameter of wheels, 42ft.; face of paddles, 12ft.; diameter of cylinder, 105in. by 10ft. stroke of piston. The steamer was built by Webb and Bell, and the machinery at the well-known Novelty Ironworks. As shown by the illustration, she was a two-masted steamer with two tiers of deck houses superposed.

The Great Republic, Fig. 14, Japan, and China, being sister ships, formed the largest paddle-wheel beam engine liners of the Pacific fleet. The Great Republic, evidently a fine ship, from our illustration, was built by Henry Steers. Her dimensions, according to a notice published with a large coloured lithograph of her, by Endicott, of New York, were as follows:—Length on water-line, 360ft.; breadth of beam, 50ft.; register tonnage, 3882; builder's measurement, 4850; length on spar deck, 380ft.; cylinder, 105in. diameter by 12ft. stroke. In the list of steamers given at the foot of an engraving showing the screw liners City of Peking and Tokio, the three paddle

Name.	Tons.	Material.	Passengers		Freight.	Coal.
			Cabin.	Steerage.		
Great Republic	4300	wood	150	1200	1900	1500
Japan	4300	do.	150	1200	2100	1450
China	4300	do.	156	1200	2000	1500
Alaska	4100	do.	130	1000	2100	980
Constitution	4100	do.	175	800	2000	1000
Colorado	4000	do.	150	1000	2000	1000
Arizona	2700	do.	130	500	1775	800
Montana	2700	do.	130	500	2000	750
Rising Star	2700	do.	130	500	2000	775
Henry Chauncey	2600	do.	130	600	1765	700
Nevada	2100	do.	120	600	850	500
New York	2100	do.	120	600	1000	520
Costa Rica	1900	do.	120	800	900	500
Oregonian	1900	do.	120	500	900	400
Golden Age	1900	do.	130	600	900	500
Ancon	1500	do.	50	150	750	400
Mohongo	1300	iron	75	300	700	400
Orizaba	1200	wood	75	200	600	350
Senator	1000	do.	60	100	450	200
California	900	do.	60	100	500	200
Pacific	900	do.	60	100	500	200

liners, China, Japan, and Great Republic are mentioned, all three as being 4300-ton vessels; whereas the descriptive notice on Endicott's lithograph gives for the Japan and China the following somewhat differing dimensions:—Japan, built by Henry Steers; length on water-line, 360ft.; breadth of beam, 50ft.; depth of hold, 31½ft.; register tonnage, 4352; carpenter's tonnage, 5200; length on spar deck, 380ft.; breadth over all, 79ft.; engine by Novelty Works, cylinder, 105in. by 12ft. stroke. China, built by H. Webb; register tonnage, 3836. The Japan and China, were much alike in all constructive details,

which we need not here again dwell upon. Probably a number of this long list of paddle steamers may still be in service, though most likely on other routes than those for which they were originally intended. The Pacific mail steamers, after all, undoubtedly at their time were the most important fleet of United States paddle liners. It seems astonishing, however, that single-cylinder beam engines were found, for ocean service, so useful and satisfactory that a great number of boats were all alike fitted with them, and it seems not at all surprising to read, in the earlier published notices referring to the Pacific paddle liners, that in stormy weather the engines made but a limited number of revolutions per minute, and the engineers had to stand by with the starting bar to help the cranks over dead centres. As we stated in our last notice, and upon the withdrawal of the American mail steamers from the New York and Havre line, the French Compagnie Générale Transatlantique took up that trade and began with some eight paddle liners built by the firm of Scott and Co., Greenock, and later on they added, and so continued up to the present date, screw steamers of more important size and tonnage, these in the earlier vessels having been built, if we do not mistake, by the firm of R. Napier and Sons, Glasgow. The paddle steamers were mostly constructed from French designs of a not very favourable general appearance, rather resembling large paddle tug boats than ocean mail liners; their last paddle steamer of comparatively large size, the Napoléon III.—Fig. 16—was undoubtedly by far the finest boat—iron built—they had owned up to that date, and we illustrate this vessel, which conveniently may serve as representative of all the earlier built though smaller size paddle steamers of the French company under consideration. They all had side lever engines,

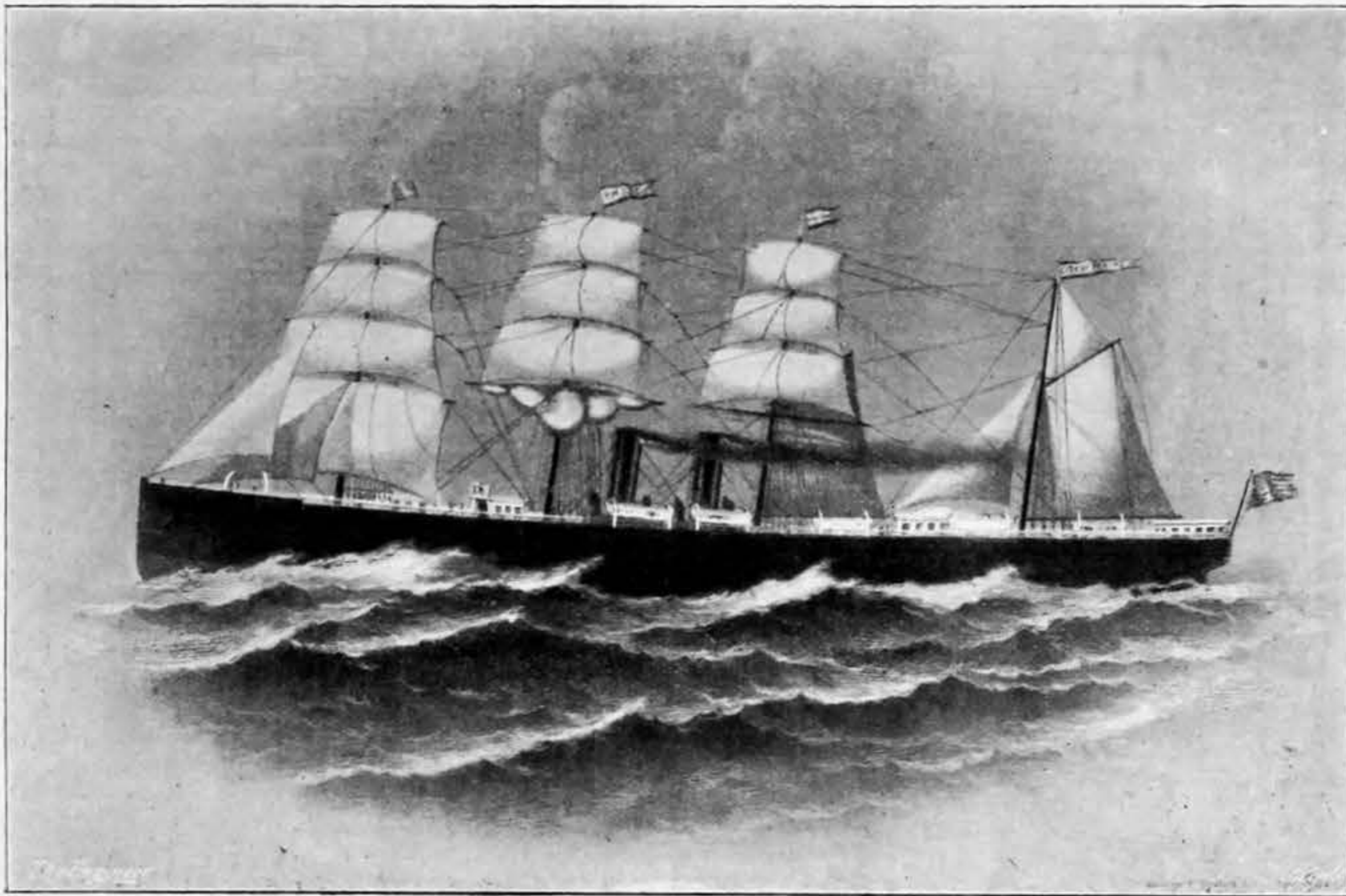


Fig. 17—CITY OF PEKING

but we think most of them were not in service for a very extended period as paddle vessels, being soon after converted into screw steamers and lengthened, which type of liner the company more advantageously might have taken up from the beginning, for in about 1862, when its first paddle boats were put in service, the English companies built their last paddle liners, and were just adopting the screw propeller on a more extensive scale, leaving off building new paddle steamers. We have no information as to what may have been the final fate of the remaining French transatlantic paddle liners, and we have not been able to procure the data which it was our desire to give here regarding details of machinery and dimensions of the vessels under consideration, but we should suppose their side lever engines were of a type retaining the most prominent features of the later Cunard paddle-liner engines.

GERMANY'S SURVEY FOR THE BAGDAD RAILWAY.

THE expedition set on foot by the management of the Anatolian Railway Company for the purpose of investigating the economic and technical conditions involved in an extension of that railway to the Persian Gulf set out from Constantinople on September 16th, and journeyed by rail to Konia. The leader of the expedition, Herr Stemrich, Councillor of Legation and German Consul-General at Constantinople, had set out thither some days previously. From Konia the expedition will make its way on horseback along the route already indicated in the German Press, and it is expected that the course of the future railway will be determined during the journey.

After traversing the broad plain, of which Konia, the Iconium of ancient times, is the central point, the mountain range of the Cilician Taurus has to be passed and the descent made to Adana, a city of 30,000 inhabitants, situated on the river Sihun or Sarus, thirty miles from the sea and commanding the pass of the Taurus Mountains. From Adana there is already a branch line of railway about sixty kilometres in length running to Mersina, a port on the Mediterranean, so that nearly midway between Constantinople and Bagdad there is the means of connecting an overland railway with

the Mediterranean Sea. Between the low-lying district of Adana and the Upper Valley of the Euphrates there is another range of mountains to be crossed, which is known on the map as the Amanus or Akma Dagh range, and the fruitful province of Aleppo is then reached. The capital, Aleppo, was the chief emporium of trade between Europe and Asia before the discovery of the sea route to India. A branch line *via* Aleppo would connect the projected railway with the Syrian Railway system. At Biredjik, 152 miles due east of Adana, the expedition will cross the Euphrates, and proceeding in a southerly direction from Mount Taurus and across Upper Mesopotamia will arrive at the river Tigris. Hitherto the mountain ranges have presented great difficulties to railway construction; in the level plains of Upper Mesopotamia the extraordinary number of intersecting streams, tributary to the Euphrates and rising in the Karadja Dagh Mountains, will, according to previous explorations, require a great amount of careful work. In summer these river beds, on an average fifty-five yards in width, are dried up; but the huge masses of stone which are allowed to remain in the river courses are hurled along by the heavy torrents of the rainy season, and there is a perpetual danger of inundations.

In the Valley of the Tigris the expedition will visit the decayed town of Mosul on the right bank of the Tigris, opposite the ruins of Nineveh, and 200 miles from Bagdad. Then Arbela, or Erbil, and Kerkuk, both situated on tributary streams of the Tigris, will be visited; and, finally, the expedition will thus reach Bagdad. Setting out from Bagdad and crossing the Tigris and Euphrates, the expedition will make its way along the right bank and down the latter river. Kerbela, sixty miles S.S.W. of Bagdad and Redshef, both of which towns are Persian centres of pilgrimage, will be taken before Basra, or Bassorah, is reached. This town of Asiatic Turkey, containing about 40,000 inhabitants, lies on the west bank of the Euphrates, fifty-six miles from its mouth in the Persian Gulf. It is probable that the journey will thence be continued as far as

Kuwait on the north-west shore of the Persian Gulf, since Kuwait seems to possess all the necessary conditions for the establishment of a terminal port.

The return journey will most likely be made along the Euphrates Valley, and the return of the expedition to Constantinople is not to be looked for before the end of next March. From the route sketched out for this survey it is to be seen that for the present the project for constructing a line of railway *via* Sivas, on the Kizil Irmak, and 170 miles south-west of Trebizond, has been allowed to lapse. A line of railway connecting Angora, Kaisarieh, and Sivas with the valley of the Tigris, with a branch line from Sivas to Erzerum, lying only fifty miles from Russian territory, would no doubt be greatly desired by the Turkish Government, both from economic and strategical points of view; but the technical difficulties would far exceed those involved in the construction of the projected line from Konia to Biredjik, and thence to the Tigris region; and, moreover, it would demand a sum of money considerably greater than the estimated cost of the latter line—namely, 400 million marks, or £20,000,000. The time allowed for building the projected line will be from six to eight years.

From a political aspect the line *via* Biredjik cannot arouse ill-feeling on the part of Russia. That country has frequently given it to be clearly understood that it would regard any construction of railways in the vicinity of the Trans-Caucasus as a direct threat. Were Asia Minor in the hands of a strong Power the question of meeting the demands of civilisation, and thereby duly opening up one of the richest regions of the world, would not remain for long dependent on the goodwill of the "Colossus of the North."

ELECTRIC HOISTING ENGINES IN THE U.S.—Electric motors are being applied somewhat extensively to winding and hoisting engines, installed for both temporary and permanent service. If a hoist is wanted for a short time for raising building material it can readily be installed and connected with the nearest electric lighting wires. The motors are of higher efficiency than the steam engines ordinarily used, because they can sustain a much greater overload on emergency. They can be started, stopped, reversed, and controlled more easily, by the simple movement of a switch controlling the current. They are compact and efficient, and are said to do more work with a given amount of energy delivered through the wires than an engine can give with the same amount of energy delivered through pipes. In the construction of a brick chimney, 230ft. high, a 7½-horse power electric hoist was used, and raised about a million bricks. At the rear end of the bed-plate are the motor and controller, with a pinion on the end of the motor shaft. This gears with a spur wheel on a countershaft, a second pinion on this shaft gearing with the cog wheel on the drum shaft. A spool or reel is on the same shaft. Electric cranes have an electric hoist, and additional motors for traversing the hoist and the crane. All these can be run at once, so that a load can be raised, traversed, and carried lengthwise of the building, all at the same time. The electric travelling crane is a feature of nearly every factory and power station. A large bridge-building company has in its yard a 10-ton steel revolving derrick with an arm 40ft. long. The central post is supported at the top by horizontal lattice girders attached to columns. The 40ft. horizontal jib or boom has a clear sweep, and the operating-house moves with it. The hoisting is done by a motor of 10-horse power, and the trolley which carries the chain is run in and out along the jib by a 3-horse power motor. Both motors are fitted with electric brakes, so arranged that when the current is shut off from the motor they automatically stop, and hold the load firmly in position.

EARLY ATLANTIC MAIL STEAMSHIPS

(For description see page 422)

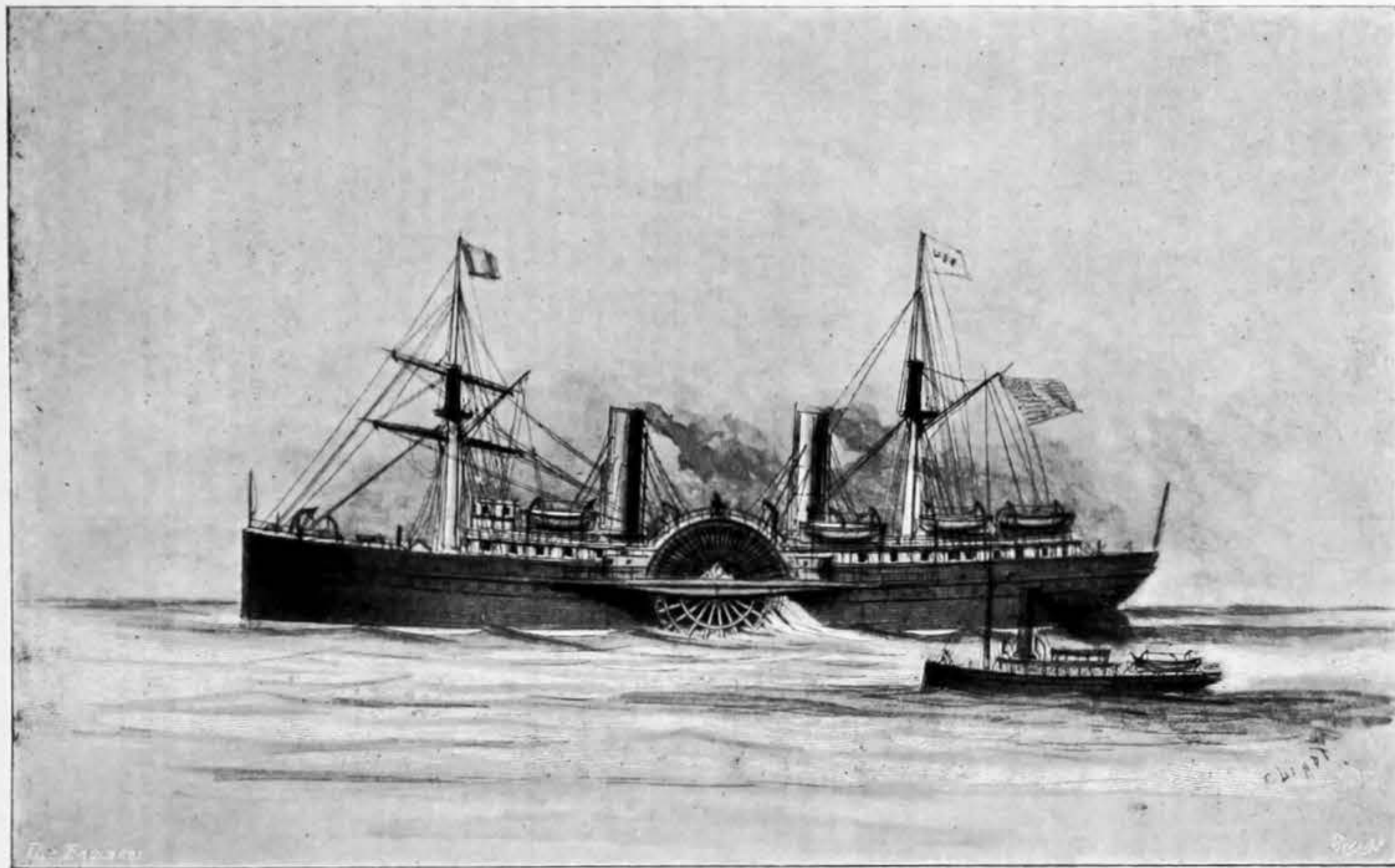


Fig. 13—VANDERBILT LINER, U.S. MAIL STEAMER ILLINOIS

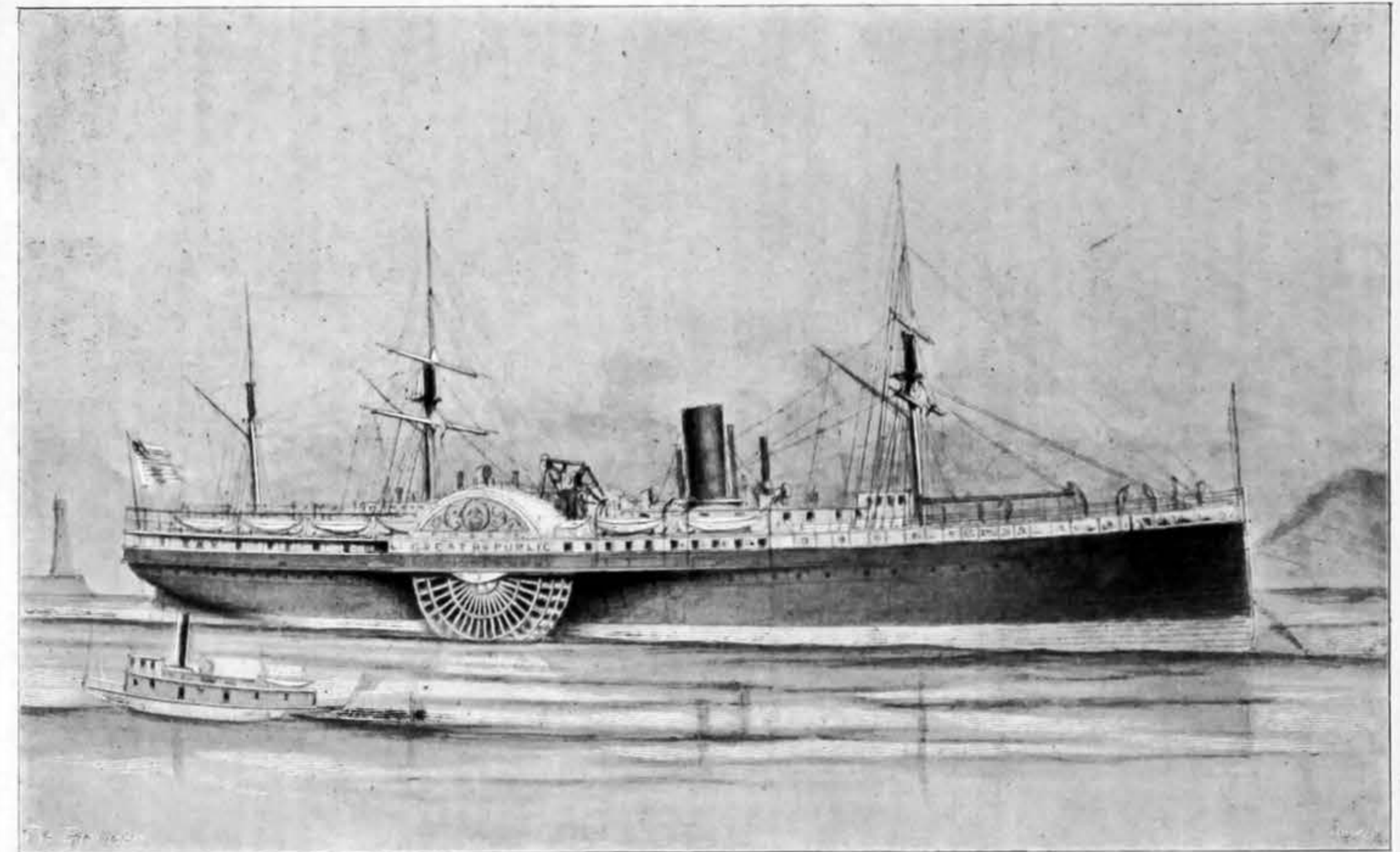


Fig. 14—PACIFIC MAIL STEAMSHIP COMPANY'S S.S. GREAT REPUBLIC

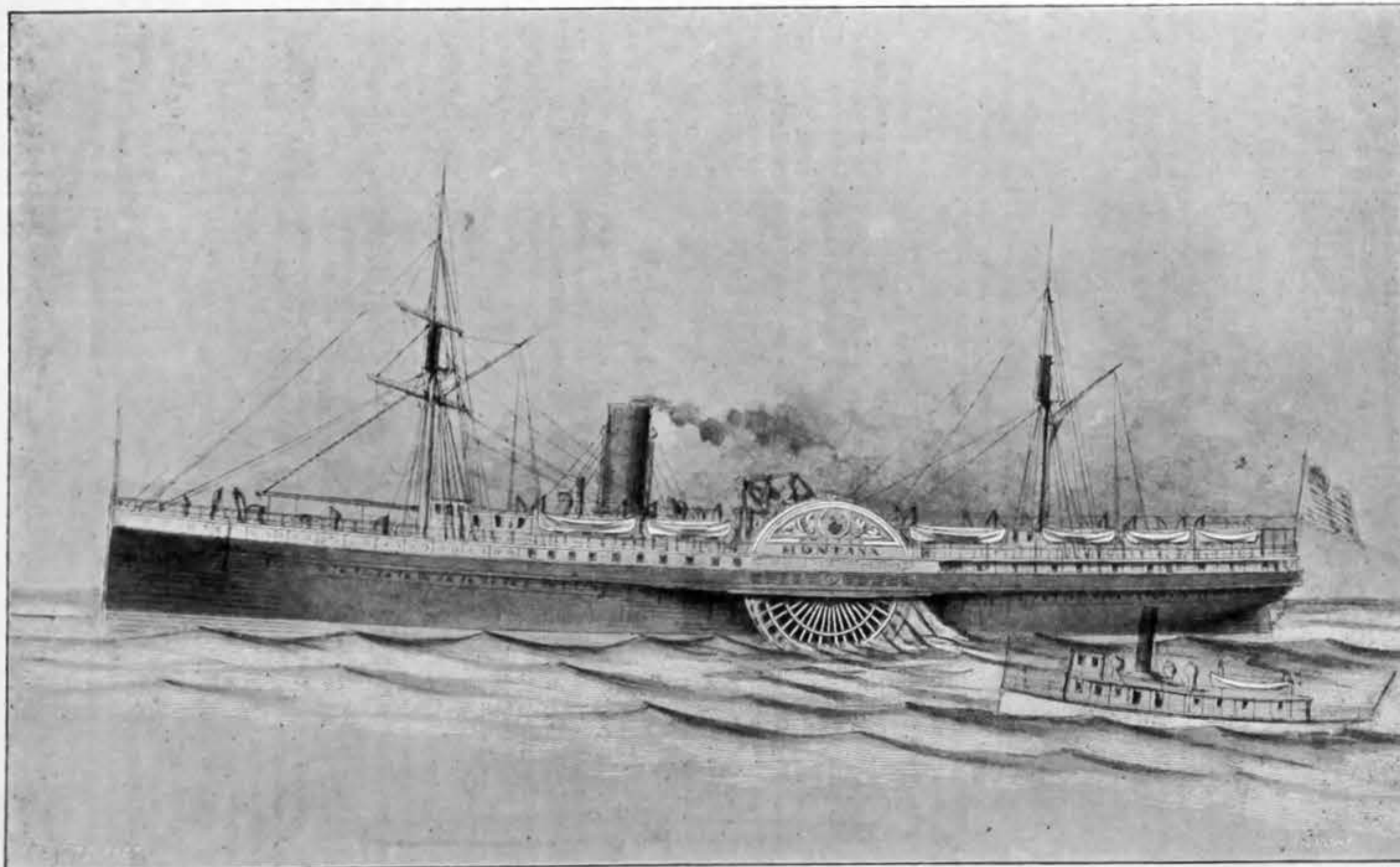


Fig. 15—PACIFIC MAIL STEAMSHIP MONTANA

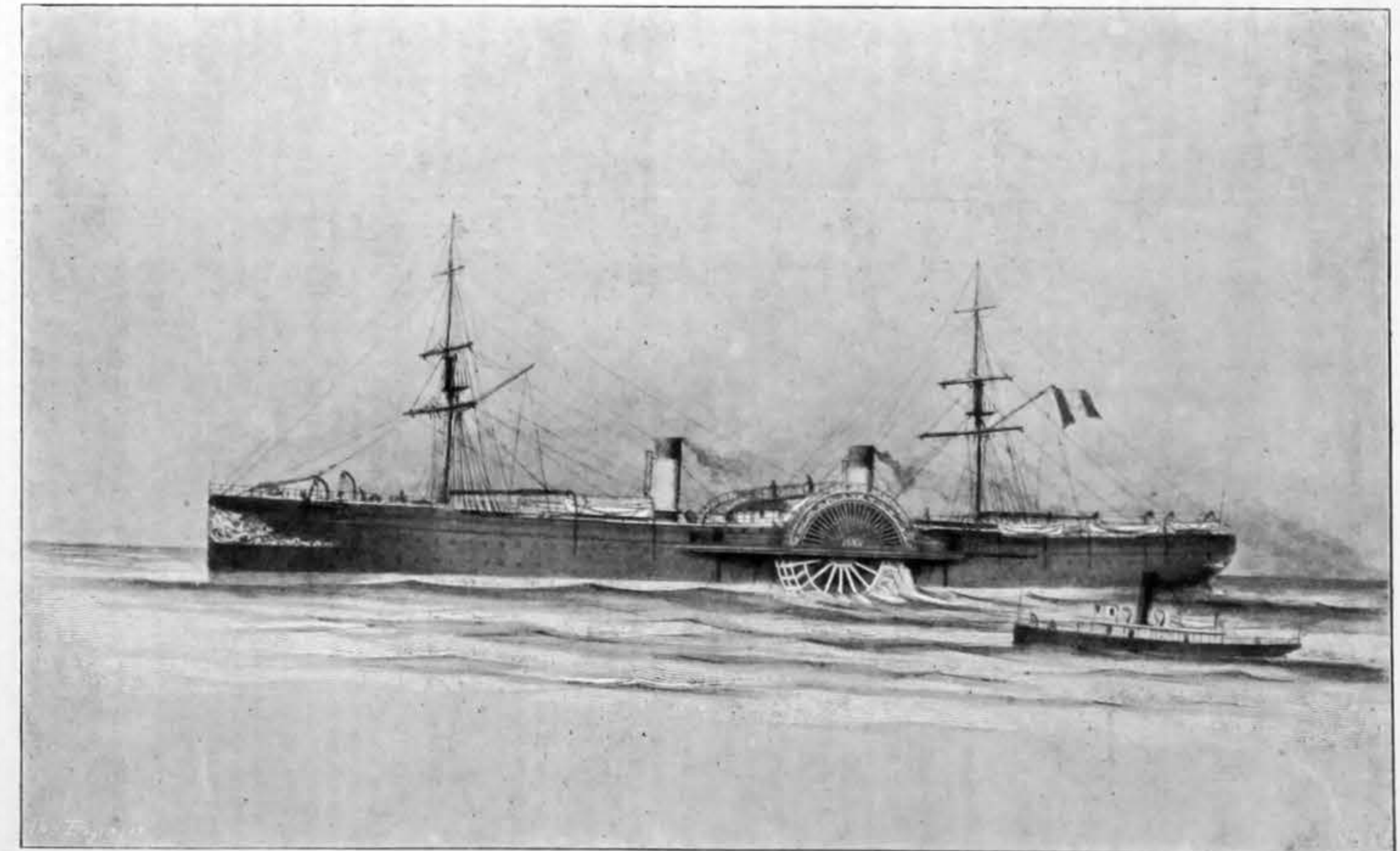


Fig. 16—COMPAGNIE GENERALE TRANSATLANTIQUE NAPOLEON III.

RAILWAY MATTERS.

THERE are 16,000 miles of electric tramways and light railways in the United States and Canada.

THE Sheffield District Railway will, in all probability, be opened for both passenger and goods traffic on January 1st next.

THE total length of Russian railways in construction during the past year by the Crown and by public companies measured a distance of 6605 miles.

THE Great Western Railway Company has already started operations on the new line which is to be constructed between Acton and High Wycombe in conjunction with the Great Central Railway.

AN inquiry has been held by Mr. A. P. Trotter at Southport, relative to the application of the Corporation for power to borrow £60,000 for the purpose of providing permanent electric tramways and their equipment.

IN reply to a question asked in the House of Commons on Monday last, Mr. Ritchie said that the necessary plant has been constructed for the experiment in electrical traction on the Underground Railway, and a train will be run early in November.

IT is expected by the end of the year that a hundred locomotives on the Boston and Maine Railway will be fitted with water grates, so that coke can be used as a fuel. In this country coke was used from 1829 to 1860, but water grates were never employed.

THE railway line from Tergu Ocna to Comanesti Palanca, which unites the Roumanian system to the Hungarian at Palanca Ghymès, has been opened. The line is thirty-five miles long, and cost rather over £1,000,000 sterling. Roumania has now four railway lines running to the Hungarian frontier.

TWENTY-FIVE new fourth-class carriages have lately been delivered at Moscow, for service on the Western Siberian Railway. Each carriage contains accommodation for forty-three passengers, and weighs 13 tons. They were constructed at the Sormovo Carriage Factory.

SOME time ago a successful experiment was made on the Baltimore and Ohio Railroad, with a view to testing the hauling capabilities of a Consolidation locomotive having cylinders 22in. by 28in., and 4ft. 6in. driving wheels. The total weight of train, composed of fifty steel cars loaded with coal, and the engine, was 3020 tons. The net weight of coal was 2400 tons.

THE railway Bills in Parliament to be deposited for the coming session are said to include a scheme for an electric railway between Croydon and Brighton, the connection with the metropolis not being as yet specially indicated. Cheap fares and high speeds are to be promised. Can this be the Behr mono-rail system?

ASKED whether the railway general managers of this country had yet decided on the most suitable communication appliance to be fixed in passenger trains, the President of the Board of Trade said there was a preponderance of opinion in favour of what is known as the "brake system" of communication, and that most of the larger companies are taking steps to apply it.

THE construction of a railway has been commenced in Borneo to connect the inland districts with the coast. At present it starts from the mouth of the Bukau River, which is on the mainland some short distance, about three hours' steam from Labuan. The line is laid from the coast village of Weston to Bukau, about six miles. From here it continues for twelve miles to Beaufort, on the Padas River, from which place eight miles more are laid.

THE Board of Trade have sanctioned the use of cable cars in Edinburgh on the route officially inspected by Sir Francis Marindin, on 12th inst, extending from Shrubhill, near the Leith boundary to Tollcross, and the Braid Hills. Passenger traffic may at once be started by cable cars on this route. An order for twenty tank engines has been received by Neilson, Reid, and Co., from the North British Railway Company, and a like number has been ordered from Sharp, Stewart, and Co.

A HUGE scheme of electric tramways for the northern part of the county of Surrey has been elaborated by the Highways Committee of the Surrey County Council, and will be submitted to that body at a meeting to be held on November 14th, with a recommendation that application be made to the Light Railway Commissioners to obtain the necessary powers of construction. The scheme includes twenty-nine miles of line, and this is only the first part of a scheme for the whole county, which will be hereafter promulgated.

THE expectations of those concerned with the construction of the Beirut-Damascus Railway have not so far been realised. This line has now been working three and a-half years. The causes of the failure of this railway may be said to be the great cost of its construction, more especially on that part of it which connects Beirut and Ma'allaka—more than a third of the whole distance to Damascus—the small amount of traffic, and the heavy annual expenditure. The line is being worked at an annual loss of £23,793.

A NEW electric railway is to be constructed in Northern Ohio to connect Toledo and Norwalk, a distance of 60 miles. The railway will be built according to good steam railroad practice, and designed for a speed of at least 40 miles an hour. One striking fact is that this line will be worked from one central power station to be established at Fremont. A three-phase alternating current will be used, which will be transmitted each way at a pressure of 15,000 volts, and transformed down at substations.

ON the Chicago and North-Western Railway a type of locomotive for the fast west-bound mail trains has cylinders 19in. in diameter by 26in. stroke, 6ft. 8in. driving wheels. Its total weight is 60 tons, of which 33 tons is on the drivers. The heating surface of the boiler is 2353 square feet. The working steam pressure is 190 lb., and the grate has an area of 30.33 square feet. The west-bound mail trains usually consist of four cars weighing empty about 40 tons each; at times, however, there are six cars in the train, and the loading varies from 16 tons to 30 tons per car.

NEXT year an Exhibition will be held at the Royal Agricultural Hall, Islington, devoted to tramways and light railways. The show will be open from June 30th to July 11th. For several years there has been an exhibition of tramway apparatus and appliances at the annual meetings of the American Street Railway Association; but the forthcoming show at the Agricultural Hall is said to be the first of the kind ever held in this country, or indeed in Europe. It is promoted by the proprietors of the *Tramway and Railway World*, and an excellent list of patrons has been secured.

THE Board of Trade has recently confirmed an Order authorising the construction of light railways from Wallingford, in the county of Berks, to Benson, in the county of Oxford, and near Didcot, in the county of Berks. The opposition to the light railway at Swansea has been successful. The decision of the Commissioners to this effect has just come to hand. The announcement regarding Swansea and the main line is not expected to be made until the parliamentary notices are out in November. The Board of Trade has also recently confirmed an Order, entitled the Glasgow and South-Western Railway (Maidens and Dunure Light Railway) Order, 1899, authorising the construction of a light railway in the county of Ayr, between Girvan and Ayr.

NOTES AND MEMORANDA.

THE total quantity of coal brought coastwise to the port of London last year was 7,378,000 tons.

THERE are 112 towns in France outside of Paris which are provided with telephone exchanges.

THERE are twenty carbide manufactories in France, most of them obtaining their current by means of water power.

UP to Saturday last there had been 1200 fewer applications for letters patent in this country than in the corresponding period of 1898. This is largely accounted for by the decrease in the number of patents connected with cycles.

THE first Bessemer rails ever made were rolled in 1856, and analysis shows that they had the following composition:—Carbon, 0.080 per cent.; silicon, traces; sulphur, 0.162 per cent.; phosphorus, 0.428 per cent.; arsenic, traces; manganese, traces; iron, 99.33 per cent. At that time the pernicious influences of sulphur and phosphorus were not yet known; and as the behaviour of the rails was unsatisfactory, their manufacture was abandoned, and not resumed till 1864.

THE principal mining counties in the kingdom, whether judged by the mineral produced or number of persons employed, are:—Durham, with an output of 34,737,347 tons of coal; Yorkshire, with 25,639,021 tons of coal, and 5,785,588 tons of iron ore; Lancashire, with 25,324,685 tons of coal, and 749,427 tons of iron ore; and Glamorganshire, which yielded no less than 19,140,742 tons of coal in spite of a strike lasting five months. The above figures are the official returns for 1898.

THE present capacity of the Leeds gasworks is equal to a production of 17,250,000 cubic feet per day. Mr. Townsley, the general manager of the works, recently gave some particulars of the carburetted water-gas plant which it is proposed to erect. A plant large enough to yield 2½ million feet per day would cost £30,350. The chief advantages claimed for this process are that by using coke it prevents this product from becoming a drug in the yard; its almost constant availability makes it most serviceable in winter time or foggy weather.

THE United States Government Patent-office is in want of examiners. The qualifications necessary to pass the examination are a knowledge of (1) physics; (2) organic and inorganic chemistry; (3) mathematics; (4) technics—test of knowledge of the manufacture of different articles and substances, &c.—(5) reading mechanical drawings, describing the construction and operation of machinery represented, and the mechanical powers that appear; (6) translation of French or German into English. The salary to commence is about £240 per annum.

THE following are the dimensions of the Grenier Bridge, at Berne, in Switzerland, which was completed last year:—Total length, 1,172.85ft.; height above low water, 161ft.; width, centre to centre, of balustrades, 41.58ft.; width of roadway, 23.76ft.; width of footways, each, 8.91ft. The bridge consists of eight spans, of which the principal one is a parabolic arch of 484.6ft. span, and 104ft. rise. The outside ribs of this arch are 26.4ft. apart at the crown, and widen out to 42.22ft. at the abutments. The roadway consists of galvanised metal troughs, upon which are laid concrete and wood blocks.

IN an article on the American Society of Civil Engineers' rail sections, in the *Railroad Gazette*, it is stated that lately there have been signs of a reaction from the strong tendency toward heavy rails. This is not a question of sections, but of weight. The heavy rails recently put in have not been always satisfactory; that is, the companies are not always getting the worth of the money put into the heavier sections in increased wear, and it would not be surprising if in future orders the proportion of weights from 80 lb. up should decline somewhat, and this is still more likely to be the case if prices keep up.

IT is expected that by the end of the present year the 8in. oil pipe line to convey petroleum from Michailovo to Batoum, a distance of 143 miles, will be finished. There are three elevating stations on the line, each fitted with pumps of 150-horse power each. The daily duty of the pumps is 90 metric tons of petroleum, or a maximum of 25,000 tons per year. The pipe line is covered with ballast, and is fitted with safety valves that automatically isolate short sections in case of accident. At Michailovo the oil is brought from the wells in cistern-wagons, which discharge directly into iron troughs leading to two tanks holding 12,000 cubic metres of oil.

THE French Government, in order to encourage the production of oil from shale, have decided to offer a special premium to the refiners for the next six years, on the following conditions:—"That in the course of the first year the total sum expended on premiums shall not exceed 300,000fr.; this sum is to be divided *pro rata* between the refiners, according to their production. At the same time, these premiums shall not represent more than 3fr. per hectolitre of unrefined oil. During the third and fourth years the total sum paid in premiums shall not exceed 200,000fr., and not more than 2fr. per hectolitre. In the fifth and sixth year the total amount is not to exceed 100,000fr., or more than 1fr. per hectolitre."

AT Snoqualmie Falls, Washington, there has recently been started a 10,000-horse power hydraulic plant, embodying several features of interest. The falls are 250ft. in height; and the machinery, which converts a part of their energy into electricity, is placed 250ft. below the surface of the upper river in a power house blasted out of solid basaltic rock. The water motors are of a unique type, being practically huge rotary pumps reversed. Each unit comprises two "impellers," which are simply large gear wheels having three cycloidal teeth each. The two shafts are geared together outside the case. Each shaft and "impeller" weighs 15,000 lb., and a complete motor weighs 50 tons.

THE official returns dealing with the mining industry of Russia for the year 1897 have just been made known. The value of the products shows an increase of 34 million roubles over the value of the products in 1896. This increase in the production is made up as follows:—Cast iron, 15,802,134 roubles; coal, 5,949,000 roubles; naphtha, 5,085,494 roubles; manganese ore, 1,760,000 roubles; salt, 1,579,220 roubles; platinum, 386,000 roubles; quicksilver, 273,000 roubles, &c. Silver shows a decrease of 157,000 roubles, and porcelain earth a decrease of 10,800 roubles. During the last ten years the production of cast iron in Russia has increased by 74 million poods, or by 3½ times; the production of steel by 61 million poods, or 5½ times; and the output of coal by 467 million poods, or double the former amount.

ACCORDING to tests recently made by Mr. A. S. Cooper, and described by him in the current issue of the *Journal* of the Franklin Institute, the use of salt or sea water in gauging cement is bad practice. The tests were made with both natural and Portland cement mortars, and comprised tensile and compressive tests. The ages of the briquettes when tested were one week, four weeks, three months, six months, and one year. In the short-time tests the briquettes gauged with salt water stood ahead of those gauged with fresh water, but the long-time tests nearly always showed the superior strength of the briquettes mixed with fresh water, and this was just as pronounced in the compression as in the tension tests. The deteriorating effect of the salt water seemed to be the greatest with the richer mortars.

MISCELLANEA.

THE French submarine boat Narval was launched last week at Cherbourg.

BICYCLES are now carried as baggage free of charge on United States railroads.

THE District Council have under consideration a scheme for a full supply of water, at a cost of £40,000.

AT Cardiff the municipalisation of the gasworks is again being discussed by the Corporation, and negotiations are to be resumed.

ON Monday last the Chinese Minister, Sir Chihchen Lofengluh, visited the Leeds Steel Works and the locomotive works of Kitson and Co., Leeds.

A VERY active programme of shipbuilding on the Great American Lakes is being inaugurated. The Carnegie Steel Company have ordered five steamers, each 475ft. long.

THE minimum endowment for the Birmingham University scheme having been subscribed, it is probable that some steps will be taken shortly for the execution of the preparatory work.

THE largest contract entered into in recent years for shipbuilding on the American Great Lakes has just been signed. This contract will call for the construction of two steel steamers each with a load water-line of 435ft., beam 50ft.

AN order for the engines and boilers for one of the first-class cruisers being built in the Government dockyards has been placed with the Clydebank Engineering and Shipbuilding Company, Limited. The engines will be of about 22,000 indicated horse-power.

SINCE the opening of the Dortmund-Ems Canal, six months ago, more than 300 vessels have entered or left Dortmund harbour, the incoming vessels bringing 24,700 tons of cargo, and the outgoing ships taking away 14,200 tons, being a total movement of 38,900 tons of cargo.

THERE are five coal-producing centres in the Transvaal, namely, Boksburg, Heidelberg, Middelburg, Lydenburg, and Klerksdorp. The three former are by far the most important, and contain between them twenty-four mines. The total production in tons last year was 1,907,808.

THE opening meeting of the twenty-sixth session of the Liverpool Engineering Society will be held on the evening of Wednesday next, November 1st, at eight o'clock, when the President-elect, Mr. A. Bromley Holmes, M. Inst. C.E., M.I.E.E., will deliver his inaugural address.

THE Canada Atlantic Railway Company has completed arrangements, it is stated, for the purchase of a fleet of steel steamers, which will next year operate on the Lakes in connection with their rail system to Quebec, where terminal facilities will be constructed to vastly increase the importance of that place as an export shipping point.

THE United States submarine boat Holland, of which a good deal was heard some time ago, does not appear to have proved an unqualified success. Last week, getting out of control, she ran while submerged into the dock at New York, and the crew were eventually taken out in an unconscious condition. The Holland is said to have made a submerged run of a mile in ten minutes.

WHAT is said to be the largest rope cable in the world has been in use for some time for the Glasgow District Subway. It was manufactured by D. H. and G. Haggie, of Sunderland, and its weight is about 55 tons. Its life has proved to be 14½ months, the previous record being 10½ months, and during this time it has run 85,000 miles, whilst the previous best record was 61,000 miles.

IT is claimed that the deepest oil well in America is situated in the Monongahela River Valley, about 25 miles from Pittsburgh. The hole has been drilled to a depth of 5532ft., but work has been suspended owing to a break in the 2½in. rope used. As a result 1000ft. of rope and a string of tools are at the bottom. Experts are at work, and hope to be able to resume drilling soon. It is proposed to sink the well 6000ft.

THE Brewers' Exhibition at the Royal Agricultural Hall, Islington, opens to-morrow, Saturday. In the malting barley competition, held in connection with this Exhibition, the list of awards has been considerably added to and the number of classes extended, and the entries, we learn, are likely to be a record number. To further the joint interests of farmers and brewers valuable prizes are again offered for English hops.

ONE result of the late Belgian miners' strike has been to foster in that country foreign competition, which has profited largely by the situation, writes the *Charleroi* correspondent of the *Organe Industriel*, who reports that a great deal of foreign coal has been imported, viz., British coal, chiefly *via* Antwerp and the Charleroi Canal, Pas-de-Calais coal, and Ruhr coke. Luxemburg ironmasters are bitterly complaining of deficiency in the coke supply, which is directly traced to the Belgian strike.

AN attempt made some time ago in Germany to convert coke dust into briquettes, with a cement consisting of cellulose residue, did not succeed, because a prolonged drying in the open air was necessary for the briquettes to stand carriage; but in that case they crumbled in the fire, while they also burned so slowly that the furnace could not be kept at the desired temperature. For counteracting these disadvantages it was proposed to mix nitrate of soda with the cementing substance; but the only method which has hitherto been found to give good results is to use the dust itself as fuel, with one of the devices for feeding powdered fuel which have recently been introduced.

THE Board of Trade have received through the Foreign office copies of communications from the offices in London and Paris of the Royal Commission for the Paris Exhibition, respecting applications from British workmen for employment in connection with the Exhibition buildings. It appears that there has lately been some influx of British workmen into Paris with the object of obtaining work on the buildings, and, in view of the number of applications made at the Paris offices of the Royal Commission, it is thought desirable to point out that the French contractors are unlikely to employ foreign labour of any description, while foreign contractors charged with the erection of various foreign buildings import their workmen, as a rule, from their respective countries.

AT Indian Head the United States Navy Department is erecting a new factory for the manufacture of smokeless powder, which will be operated entirely by electricity. The electrical plant will serve to drive the machinery and the trolley trams, as well as generate electric light. The generating plant consists of two 250-kilowatt double-current generators, and one 75-kilowatt two-phase generator. Each of the two larger machines can deliver current simultaneously from both sides, a continuous current at 550 volts, and a two-phase current at 400 volts. The smaller machine generates two-phase current at the same voltage and frequency. An 18½-kilowatt transformer in the generating station steps up the alternating-current voltage to 1100 for supplying a feeder line for lighting the various buildings. The machinery in the mills is driven by induction motors, and the continuous current supplies power to the railway system, which is operated partly on the overhead trolley and partly on the Westinghouse surface-contact system. The crane motor in the proving grounds is also supplied with continuous current.

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Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.

Advertisements cannot be inserted unless delivered before six o'clock on Thursday evening; and, in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than three o'clock on Wednesday afternoon in each week.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of THE ENGINEER.

Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

PUBLISHER'S NOTICES.

With this week's number is issued as a Supplement a Two-page Engraving of Compound Corliss Engines, Sheffield Electric Tramways. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.

If any subscriber abroad should receive THE ENGINEER in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.

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TO CORRESPONDENTS.

- All letters intended for insertion in THE ENGINEER, or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.
We cannot undertake to return drawings or manuscripts; we must, therefore, request correspondents to keep copies.

REPLIES.

- G. B. W. (Lime juice machinery).—A letter has been forwarded to you from The Masson and Atlas Works, Litchurch, Derby.
H. C. F.—We are not aware of the existence of any trustworthy statistics giving the number of boilers at work in Great Britain.
J. K. M. (Thames Ditton).—If you like to send us drawings and description of your invention, we will tell you what we think of it.
T. H. (Goswell-road).—Your invention proposes to accomplish an impossibility, and you will waste your money if you proceed further with it.
RUBBER.—See Cantor Lectures by Obach. Published for the Society of Arts by George Bell and Sons, York-street, Covent-garden, London. Price 2s. 6d.
J. C. (Wimbledon).—It would take too much space to describe the action of the single-trigger gun in this column. We believe Cogswell and Harrison, Bond-street, have a model, which, doubtless, they would be pleased to show you.
ASSOC. M. INST. C.E.—We would recommend you to put the matter into the hands of an expert. Why not apply to Mr. Sydney Brough, secretary of the Iron and Steel Institute, 27, Victoria-street, for an introduction to some one interested in the subject?
S. J. L. (South Hackney).—We cannot pretend to say what constitutes an invention or an inventor. The most eminent judges in the world have experienced the utmost difficulty in deciding the point, as the record of numerous patent trials goes to show.
LUBRICATION (Pershore).—We have no doubt that all your trouble with hot bearings is due to the use of too much brass. Cut it away freely at the sides. No bearing should be in contact with more than three-fifths of the journal surface. Put the oil in at the side, not at the top.
AQUARIUS (Ryde).—There is no difficulty in fitting a log to your yacht, which will show the speed at which she is going through the water at a glance. The Berthon continuous log will do this. You can obtain full particulars of this beautiful instrument from the Berthon Boat Company, Romsey, Hants. There is no other log, so far as we are aware, that will comply with your requirements.
M. McK. (Aberdeen).—Flexible couplings between the motor and the dynamo have been and are frequently used. They remove the necessity for exact alignment, and to a certain extent reduce shocks. They are also used where it is desired to insulate the dynamo from the motor shaft. An example of the use of the Raffard coupling occurs at the Aigle electric station, described in THE ENGINEER, September 8th last.
R. R. (Madison, Wisconsin).—In reply to your six queries, we would, in the first place, refer you to the article on American shipping, which you will find on page 426. (1) The British Government has subsidised mail routes in order to secure the cheap, rapid, and regular transport of letters. Mail steamers cannot be made to pay unless they are liberally remunerated for carrying letters. (2) Competition reduces the price of mail contracts to about the lowest remunerative point. (3) The growth of the British marine has not been promoted by Government aid; on the contrary, it has been hampered by various legislative restrictions. (4) It is next to impossible to say what percentage of our total shipping gets postal contracts; it is not large. (5) Yes. (6) Wages vary continually, at present they are very high, platers and riveters earning from £5 to £7 a week.

MEETINGS NEXT WEEK.

- GEOLOGISTS' ASSOCIATION, LONDON.—Friday, November 3rd, at 8 p.m., in the Library of University College, Gower-street, W.C., Conversazione.
THE INSTITUTION OF JUNIOR ENGINEERS.—Friday, November 3rd, at 8 p.m., at the Westminster Palace Hotel, Presidential Address by the Hon. Charles A. Parsons, F.R.S.

THE ENGINEER.

OCTOBER 27, 1899.

MUNICIPAL TRADING.

IN the current number of the Fortnightly Review we find a paper by Mr. Walter Bond on "Municipal Trading," which deserves attention. There is in it nothing, perhaps, quite new; little, indeed, that has not been said before. But Mr. Bond has grouped his arguments conveniently, and condensed much vague discussion, affirmation, and denial into a form handy for reference, and possibly convincing. Our author takes for his text the defeat by powerful municipalities, of the bold proposal to generate electricity at the pit's mouth, and distribute it at a cheap rate over a large area; and the municipal demand for permission to manufacture electrical machinery. He then goes on to consider what are the "proper duties of a municipality, and why they are so," and he discusses the entire subject under the following suggestive heads:—"The Legitimate Functions of a Municipality;" "The Injustice of Municipal Trading;" "The Profit and Loss Account of Municipal Trading;" "Municipal Indebtedness;" "The Causes of the Craze for Municipal Trading;" and lastly, "Sundry Fallacies."

There are so many arguments available against municipal trading, that it is not easy to deal with the subject within reasonable limits. Two single themselves out, however. On one Mr. Bond expresses himself clearly enough, with the other he has not dealt at sufficient length. He shows that the municipality is in the position of a speculator who, by force, compels people to invest in his undertaking. Let us fancy Mr. Hooley, for example, or the late Baron Grant, invested with such power that he could compel every ratepayer in Leeds or Nottingham to take shares in a scheme for lighting those towns. We need only state the facts in this way to recognise that the situation would be intolerable. But substitute a few town councillors for Mr. Hooley, and the thing is done. The Corporation decide that they will become traders, and then obtain loans to supply the requisite capital, and next levy rates to pay off the principal and its interest. It is urged that it is all for the good of the ratepayer. This is simply begging the question. "If," writes Mr. Bond, "the Vestry of Hampstead choose to go in for electric lighting, a purely trading venture, the ratepayer, whether he likes it or no, is obliged to take a share, or leave the neighbourhood. The inherent injustice of

municipal trading is that a free citizen of a free country is thereby forced to take shares in a trading concern. For the sake of essentials, reasonable men will surrender much of their liberty of individual action; they will be less than men if they tamely surrender their birthright for a municipal mess of mingled trade and philanthropy."

The paramount objection to municipal trading is the incompetence of the traders. Mr. Bond directs attention to this, as we have said, but he does not emphasise it sufficiently; no doubt because, not being himself an engineer, he cannot realise the full importance of the fact. Town councillors may be, and usually are, worthy men; but it is the exception to find any of them possessed of sufficient knowledge to be able to give a valuable decision on any point of technical weight. The result is, of course, that virtually the ratepayers find themselves handed over to one or more of the servants of the Corporation. For example, the electrical work of the Glasgow Corporation is to all intents and purposes in the hands of an American engineer, Mr. Parshall. Thus the town councillors first compel the ratepayer to invest, and then turn the money over to the control of a man, the merits or demerits of whose schemes they are quite unable as an official body to determine. The recent scandal shows how the system may work and does work. The only check on abuses is the influence of the Press. In the case of Glasgow this has failed to prevent many thousands of pounds going to the United States for engines which the Corporation admit might just as well have been built at home. For while the E. P. Allis Company has got the order for one engine, John Musgrave and Sons, Ltd., of Bolton, have got the order for the other. Now it is obvious that if the English firm can build one they could have built two, and that at a reduced price, because of the duplication of parts from one set of patterns. To all intents and purposes the engineer and his staff must, as far as the ratepayers are concerned, be masters of the situation. But this might work out beneficially when the engineer is a first-rate man. There is, however, always the risk that he will be hampered and harassed in all his operations by councillors who do not possess the information essential to any sound criticism of his doings. In most bodies of the kind one or two men will be found who dominate their fellows; and such individuals are quite competent to make the engineer's life a burthen to him, and effect much mischief by their interference. There is not a municipal engineer in Great Britain who will not endorse what we say. Now, all joint-stock enterprises worked on legitimate lines include in the board of directors men who thoroughly understand the nature of the business carried on, either from the manufacturing or commercial side, or both. The shareholders' money has, therefore, a fair chance of being properly spent. But the trading of a municipality is carried on by a board of directors who have no special knowledge, save by chance, of the business being transacted, and the members of which are liable to dismissal at any moment, usually for the same political opinions that have led to their election. It is almost marvellous that, under the circumstances, municipal trading turns out in certain cases as well as it undoubtedly does.

An evil influence militating strongly against municipal trading has as yet hardly had time to make itself felt. We refer to the certainty that nothing but stress of most adverse circumstances will induce a municipality to go with the times and adopt improvements. "Imagine," writes Mr. Bond, "a trading concern, the accounts of which are not annually audited by competent and independent auditors; imagine this concern to be specially favoured by the Legislature and to possess great influence therein; imagine it to be completely shielded from competition and largely shielded by the apathy of the shareholders from inquiry. What would be the opinion of a shrewd business man as to the probable effect of all these accumulated soporifics upon the energy, skill, and purity of the management of the undertaking? Would he not predict, and with reason, sleepiness, extravagance, maladministration? Yet a trading concern such as is outlined above is nothing more than a municipality engaged in trade."

But let us, for the sake of argument, assume that a corporation is free from all the trading defects to which we have called attention, and consider whether it is or is not in the best position to supply the wants of the inhabitants of the town or city under its control. Rightly we should extend the question, and make it apply to all corporations and towns. Is a corporation, even when, as presupposed, perfect, justified in doing any experimental work whatever? We think it will be agreed that it is not. There are cases, as, for example, when sewage has to be disposed of, when the ratepayers' money must be spent on experiments, because there are not sufficient data available to prevent the solution of difficult problems by the trial and error system being necessary. But such a case has nothing in common with, let us say, electrical plant. A corporation going to spend large sums of money, must try and spend it to the best advantage on some approved system. That done, further investigation and experiment are at an end. Thenceforth the corporation stand in the way of progress. We shall not say that they will stop progress altogether, but they must follow; they dare not attempt to lead. But, beyond this, we have the fact that corporations are, from the very nature of the case, not in the best position to promote advancement. We may use, for instance, the objections urged against the scheme for supplying light and power direct from the coal districts. The opposing corporations could not argue that they were able to supply both at a lower price; all that they could urge was their vested right. And it is evident that not one of the opposing corporations could themselves embark on a scheme full of promise, and almost certain to give consumers electricity at a much lower price than could the corporations.

To what point municipal trading in the future may extend it is very difficult to say. So far as can be seen,

there is as yet no limit fixed to the range of the undertakings in which the ratepayers' money may be embarked. Mr. Bond holds that the operations of a municipality should be restricted to such work as cannot by any reasonable use of language be said to benefit any one section of a community more than any other. Every municipal undertaking should be essential to the general welfare. But the advocates of the system do not ask much more than this. We hold that such a definition of the functions of a corporation is much too wide. Let us suppose, for example, that the Town Council of Nottingham proposed to manufacture boots and shoes for the inhabitants; it cannot be said that trading of this kind would benefit any one section more than others, because all alike wear boots and shoes. Up to the present no proposal of the kind has been made. But it is very difficult to state reasons why electricity or gas should be made and supplied, and not boots shoes. But if boots and shoes, why not bread, as has actually been done in some places in France? There can, we think, be but one answer to this. The system thus extended would be nothing more than a form of socialism, and would, in a very short time, be attended by stupendous abuses. The legitimate trading functions of a corporation begin and end, we think, in wholesome competition. If it is proved that private companies, enjoying a monopoly of the supply of public things, do not serve a city as well as it might be served, then it is quite fair that the corporation should step in. But the corporation should not be given any advantage over the legitimate traders. Pushed beyond its present limits, the policy of municipal trading cannot fail to work for evil. But the whole drift of municipal opinion is in favour of a forward policy. It remains for Parliament to consider the question very seriously. It cannot be right for a corporation to deny its ratepayers any advantages that can be derived from outside competition.

LOCOMOTIVE FIRE-BOXES.

In another page we illustrate and describe a locomotive engine which is possibly the latest novelty in the railway world. We refer to the engine with a corrugated cylindrical fire-box, designed by Mr. Vanderbilt, and working on the New York Central Railroad. Corrugated fire-boxes are not really new, having been made by the late John Haswell, of Vienna, years ago; and at least two were constructed in this country by R. and W. Hawthorn, Leslie, and Co., Limited, as far back as 1884. It seems, however, that the American engine is distinctly original in certain respects; and as such it is entitled to consideration. It is not easy to see how it could be used on an English railway. The great defect of all cylindrical fire-boxes is the small space which they give for a grate—and grate surface is all important in a locomotive. The Vanderbilt boiler has a furnace nearly 5ft. in diameter. On United States railways, boilers of much larger diameter than we can use are available; and so a method of construction which is prohibited in our country may answer very well in another.

The fire-box of a locomotive is in every sense its weak point. It is very expensive; it wears out rapidly; it requires frequent repairs; it is always liable to become leaky at the tube ends; it has to be petted and pampered in various ways; and it is invariably too small, or, to put it more accurately, too narrow. It may be taken for granted that 3ft. 3in. is the utmost width of grate that will be tolerated on an English railway—not that it represents the maximum possible width. If we also take it for granted that 6ft. is the longest grate that can be properly fired, we have at once 19½ square feet as the maximum. By making the grates a little more than 6ft. long, and measuring the bars along the incline, we get a grate with 20 square feet of area, and this may be taken to represent the dimensions used in at least 90 per cent. of the more powerful express engines of the day. With coupled trailing wheels it is very difficult to get in a grate much longer than 6ft. because of the side rods, which it is not safe to make very long. It will be seen that on the American engine a much larger grate area is secured, and some other advantages are obtained by avoiding the use of a rectangular fire-box, and after all allowance has been made for this exceptional position, which Mr. Vanderbilt holds, and which has obtained him an opportunity for trying something new which would certainly not be afforded to many, there still remains, we think, enough merit about such inventions to make us ask whether there is any sufficient reason for limiting our own practice to the small rectangular fire-box normal to British railways. It is noteworthy that, no matter what enlargements have been made in the dimensions of locomotives—and there have been many of late years—the grates have not increased commensurately; and every locomotive superintendent knows, and usually admits, that he would like a bigger fire-box if only he could get it. The limitations in width are due to the narrowness of the gauge of our roads—in part. The shortness of the box is due to the supposed difficulty of firing a grate more than 6ft. long, in the first place; and to trouble with coupling rods, in the second place. Both these difficulties may be got over, and are got over in the United States. Is there any good reason why we should not get over them here?

In Belgium engines with grates 10ft. by 7ft. are to be found; locomotives with 45 to 50 square feet of surface are common enough. The poor slack which is used for fuel must be spread thinly in order that it may burn at all. We give this week some particulars of a gigantic locomotive being constructed in the United States which has a grate of the normal width, but 11ft. long. The surface is 37½ square feet, but even this is much too small for the heating surface, which is 3500 square feet. Such a grate cannot be fired in the ordinary way. No doubt it is laid on a steep incline. The coal is heaped under the fire door, and slides down the incline by the shaking of the engine, a method much favoured on some lines in this country by firemen, who, however, are always able

to fill holes far back under the brick arch by the direct use of the shovel in a way that we should think out of the question with a grate 11ft. long. It is always said at this side of the Atlantic that locomotives more powerful than, let us say, those put by Mr. Aspinall on the Lancashire and Yorkshire, or by Mr. Webb on the London and North-Western, cannot be made, because nothing bigger will fit the road. But, after all, the key of the position is the fire-box. If it is made large there will be plenty of steam, whatever else may fail; a truth very fully realised by Mr. Drummond, whose great four-cylinder engines are largely dependent for steam on the huge fire-box surface got by adding water-tubes. Is there, then, any reason why we should not resort more fully than we have yet done to American practice in designing the extremely powerful locomotives which the exigencies of modern traffic demand? We do not for a moment suggest that we should slavishly follow any example, or copy any locomotive; but when designing locomotives, British engineers may, we think, find in American practice direct and substantial proof that certain things may be done, the success of which might otherwise be doubtful.

In designing, then, the most powerful passenger locomotive that can be put on our roads, the fundamental proposition is that the fire-box and its grate are all important—so important, indeed, that everything else is subordinate to them. With big boxes and big grates there is certain to be plenty of steam to drive up hill and down hill at a high speed. Once this is admitted, we can see our way pretty clearly to all the rest; but so long as the grate surface is kept down to 20ft. or so, real satisfaction and contentment cannot be had. Little is to be gained by augmenting tube surface. If every locomotive in the kingdom had its tubes shortened by 12in. its steaming power would scarcely be affected. But let us suppose that to make up for the 12in. cut off, the fire-box is lengthened a foot, and the grate augmented in area by over three square feet, what follows? We need not answer this question. The small grate can only be made to do by resorting to a very heavy draught, which means a small blast nozzle and great back pressure; a large grate and a large nozzle ought to and usually do go together. How is the desirable area of fire-box to be had? Several ways suggest themselves. In favour of each something is to be said; against all objections can be urged. Let us suppose, however, an engine of the type designed by Mr. Stroudley, with four wheels coupled in front. These engines run at high speeds with steadiness and safety. Let the rear end of the engine be carried on a bogie; we shall then have something very much like Mr. Billinton's big tank engines on the London and Brighton line. With a traversing bogie the wheel base may be made long; but in any case it is easy to carry the grate far back and pitch it high enough to secure good firing on the American system. A fire-box 8ft. long would give about 26 square feet of grate surface, and we should have an engine with nothing very abnormal about the design. Again, let us take an engine like Mr. Worsdell's six-coupled express locomotive recently illustrated in our pages. It is easy to see that no insuperable difficulty stands in the way of extending the fire-box further back over the trailing axle, and the fact that the engine has outside cylinders permits the fire-box to go at least 6in. further forward. Thus again we can get a long grate.

It is sometimes urged against long fire-boxes that they are objectionably weak in the crown. But this argument has, we think, little force. If the crown stays run fore and aft, then, indeed, length would be a source of weakness; but there is nothing to be urged in favour of the fore-and-aft stay, and many things against it; as, for example, the certainty that in time the tube holes will be crushed oval. But it is not, we think, necessary to do more than mention this objection. If those who design locomotives once become convinced that the fire-box ought to take precedence of every other consideration, then a way out of difficulties will soon be found, without any resort being had to extravagance in the general appearance of the engine, or any sacrifice of the dainty proportions and simplicity of outline which now make our locomotives the most beautiful in the world.

AMERICAN SHIPPING.

THE wholesale withdrawal of steamers from the Atlantic trade for transport purposes, and the consequent rise in freights, are bringing the United States to a proper realisation of the inadequacy of its mercantile marine in relation to the foreign trade of the country. It is certain that in his next message to Congress, President McKinley will repeat once more his conviction of the urgency for some reform of the navigation laws; and that, in the forthcoming session, determined efforts will be made to secure the passage through both Houses of the Hanna-Payne Bill, which is a thoroughly Protectionist measure, and which seeks to encourage the growth of an efficient and large merchant service by the distribution of bounties, navigational as well as constructional—that is to say, so much per ton to builders in order that they may suffer no disadvantage from what is euphemistically and quite erroneously described as the "pauper labour" of the United Kingdom and the other maritime countries of Europe; and so much per ton to owners for every given distance covered in the foreign trade in order that there may be compensation for the heavier cost of working American as distinguished from European vessels. The present position of American shipping is referable, of course, to the perpetuation, in the supposed interests of American wooden shipbuilders, of navigation laws which became obsolete from the day the first iron ship was put into the water. Slight modifications have been made in these laws, in the last half century, but they have not altered the situation materially, and it remains, as a general principle, that American citizens may not own vessels save those constructed in native shipyards. Special dispensations have been given from time to time for special reasons, and in this connection the granting of American registry to the Inman line steamers will occur to the mind at once. But the sum total of the

tonnage transferred to the American flag is absurdly insignificant when weighed in the scales against the tonnage of the commodities entering at and clearing foreign from American ports, or against the tonnage of all the vessels carrying these commodities. The gross capacity of the American vessels available for ocean traffic to-day does not exceed 300,000 tons out of an aggregate of 2,300,000 tons, while England possesses close upon 13,000,000 tons. The proportion of American trade carried in American vessels, on the basis of value, was 12 per cent. in the last fiscal year, whereas forty years ago it was 66 per cent. At that time American ships not only took a good share in their own country's foreign commerce, but were serious rivals to English ships in English trade with countries other than the United States. This, however, was before iron came in as a material and steam as a motive power. Now, American ships are virtually unknown in the trade between neutral countries, and out of about 24,500,000 tons of shipping clearing from American ports in the course of a year, not much more than one-fifth flies the Stars and Stripes; and as showing incidentally how much of America's loss in this respect has been Great Britain's gain, it may be stated that out of 18,000,000 tons of exclusively foreign shipping cleared, 12,000,000 tons are English. We have secured a similar preponderance in other markets. The adoption of our policy of free ships coincided in point of time with the appearance of iron and steam in shipbuilding, and it would be impossible to find a clearer justification of the policy than that furnished by the actual outcome to-day.

It is open to the American nation to do one or both of two things in order to remove the reproach implied by the existing condition of its merchant marine. It may initiate for itself a policy of free ships, such as was strenuously advocated for years by Representative Fithian and a handful of other earnest Congressmen. Or it may adopt the bounty system alluded to above, in order to promote a marine which shall be exclusively American. Under the first, American citizens would be permitted to acquire their ships in any market—which would in most instances mean the English market—and to obtain for them all the privileges of American registry. The initial outlay would, of course, be great, but the hundreds of thousands of pounds now sent to Europe annually in payment for charters would be saved, and this saving would in fact represent an interest on the investment. Giving evidence at the beginning of this month before the Industrial Commission which is sitting at Washington, one of the leading American shipbrokers said that in the past two years the leasing of "tramp" steamers by Americans had increased fourfold, and these vessels were netting their owners 20 to 25 per cent. a year. A few years ago, Mr. Charles Cramp, the eminent Philadelphia shipbuilder, after allowing that "with few unimportant and straggling exceptions, British steamers carry the freight and passengers of every land," objected to free ships for Americans on the ground that "the shipbuilding industry in Great Britain has been developed in such enormous proportions and the facilities of construction enlarged to such a scale, that our comparatively few and feeble shipyards would be instantly overwhelmed in the competition the moment our market was thrown open to them to unload their old and worn-out wares on American bargain-hunters." The answer to this is obvious. It takes two to make a bargain, and the American owner has a sufficiently keen eye and sufficient acquaintance with English ships to see that, if the chance were afforded him, he would get good value for his money. But the American shipbuilding industry is nothing to boast of, and it does not seem reasonable to the present administration that a crowd of foreign vessels constructed at less cost probably than in American yards, should be permitted unrestricted entry into the American register, thereby spoiling the native industry and depriving it of a "fair field" for its operations. Therefore the country is to assist its shipbuilders. The Hanna-Payne Shipping Bill, which is carried over from the last Congress, provides for the payment to American vessels not engaged solely in the coasting trade, or making voyages to foreign seaports not less than 150 miles distant from the port of departure, of a bounty on tonnage.

This bounty scheme is so comprehensive as virtually to include all but a wholly insignificant number and class of American vessels. The Bill gives a uniform rate of "compensation"—such is the phrase which sounds better to the ear of the Commissioner of Navigation than the more common one of "bounty"—amounting to one cent per gross ton for every hundred nautical miles traversed by an American-built steam or sailing vessel, the idea being "to offset the increased cost of construction and operation in the United States"—a rather curious admission after all we have heard of the progress of iron and steel in the States, the reduced cost of production, and the lowering of the rate of wages. In addition to this one cent there is to be a special allowance for steamships of more than 1500 tons gross, with a steaming capacity of 14 knots or more. The Commissioner of Navigation recently issued a sort of *apologia* for these proposals, in which he defended the constructional bounty from the charge of being "extravagant and unheard of," and said it was designed to offset the corresponding allowances given to similar steamships by foreign Governments. His argument on this matter is ingenious but extremely disingenuous. If Mr. Chamberlain knows anything of the British mercantile marine, he must know that British steamers do not receive Government support simply because they steam 14 knots an hour and have a capacity of 1500 tons or more. It has need of vessels to carry the mails, and it has held a number of our fastest steamers at its disposal for use as armed cruisers. In return for these privileges it pays a sum that is agreed upon. And yet Mr. Chamberlain contrasts the amounts received by the Peninsular and Oriental, Castle, Union, Cunard, White Star, Royal Mail, and Pacific and Orient companies for mail-carrying purposes with those which would be paid to American-built steamers of equal tonnage. Of course, the comparison—

which suggests the "figures ill-paired and similes unlike" of the poet—is well in favour of the American vessels. If the American Government were to compel their best ships, when they come to be constructed, to carry mails in return for the bounty and nothing more, there might be something in the comparison, but will it? As it stands, the contention is absurd, if it is not wilfully intended to give the American people an erroneous impression. Apart from the handful of tonnage which is supported, English steamers and sailing ships have to rely upon their own energies for profits. The capacity of the subsidised mail steamers is under 400,000 tons, and, as we have seen, the United Kingdom owns nearly 13,000,000 tons of shipping. And though they may be supported, not even the subsidised steamers were constructed with Government aid, whereas practically every vessel turned out of American yards, under the Hanna-Payne Bill, will be helped along from the moment its keel is laid.

There is another aspect of this question of American shipping and its resuscitation. At the time of the war, the Government purchased a large number of steamers for transport and cruiser purposes. Many of them were old, but the price paid was more than fair in the case of the very oldest of the lot. There was a need of steamers to replace those diverted to naval purposes, and those few native shipbuilders who were able to construct this class of vessel found themselves flooded with orders. This emergency afforded a stimulus, and made the American builders put their best energies into what was to the majority of them a new class of work. They appear to be succeeding. All along the Atlantic seaboard steamers of large tonnage are now being built; shipyards are being extended, and others are being provided—for example, the New York Shipbuilding Company is erecting on the Delaware new works which will rival anything in the whole country. Most of the vessels bought by the Government have been disposed of again, including those purchased from European owners before the declaration of war, and these with the new steamers building will form the nucleus of a really modern mercantile marine. Whether it is that they see that they can do better than they have hitherto done, or that they hope to do better by the aid of the support which is certain to come, the Americans are now paying much attention to shipbuilding, and already we have a marked addition to the output of tonnage intended for the foreign trade. They should be in a position to build ships—not the homely but useful and profitable "tramp," perhaps, but, at any rate, vessels of a type intermediate between the tramp and the "Lady" liner. One reason which was of some validity until the last few years was their inability to make plates at a cheap rate. But of late they have been sending their plates to Glasgow and underselling the Scotch article there. In other directions, too, they have reduced the cost of production; so that the principal drawback to progress has been removed. By that same token, they are in want of no encouragement in the form of bounties. The case of France and Italy is at hand to prove that this system of doles is of little use in the building up of a merchant marine when some of the essentials are wanting. But America has shown that it possesses the essentials, and bounties will help it to keep its feet until it gathers better strength. The shipowners would be glad to be permitted to purchase ships freely from abroad pending further development, but this is what a solicitous Legislature will not allow. "Free ships" would be a good thing for English shipbuilders, for whether at first or at second-hand, the vessels purchased would of necessity be of English build for the most part. But they would hardly be a good thing for English shipowners, for a new element of competition would be introduced. The development of a native American shipbuilding industry can be of advantage to neither builders nor owners here.

COPPER.

THOUGH the weakness of the copper market during the past week or two does not necessarily imply the beginning of the end of the long period of high prices, one is at least permitted to hope that the end is not far off, and to observe that the general conditions tell in favour of rather than against the aspiration. What has kept quotations up so well has been the sustained character of the American demand. Whether the whole of the heavy buying by America was for *bona fide* consumption, or whether a large proportion of it was manœuvred by the interests that have been working to keep up prices, one cannot readily say. Having regard to the industrial activity, it is quite fair to assume that the consumption has been much above the average, and that this factor has had quite as much to do with the maintenance of values, once they were moved up, as the manipulations of the Amalgamated Copper Company. The company has now to reckon without the trade. It is allowed that consumers in America have all the copper they require for some months to come, and as a result they have ceased buying almost completely. The speculators for the rise have been frightened away by dear money, the war in the Transvaal, and a recognition of the top-heavy nature of the situation. On the London market this week the representative of the Amalgamated interests has been buying freely, but has not been able to stay the decline, and, as compared with the middle of the month, standard copper at the time of writing had gone back £2 10s. per ton. If it is made manifest that the combination has got to the end of its tether—that with all the wealth behind it the concern is overloaded with stocks purchased for the express purpose of keeping quotations up to £75 or £77 per ton, the "fair" limit to which it had addressed its best efforts—then we shall have a downward movement that will be cheerful to witness. The evidences of weakness are accumulating every day. On the face of them, the statistics do not look favourable for the badly-used consumer, stocks on the 15th inst. being 20,614 tons, against 23,378 tons on the 30th ult. But this results from the shipments to the United States in the two weeks of 2275 tons of Chili bars and Standard copper, which is to be converted into electrolytic and re-shipped to this country. The withdrawal is only temporary, shipments from America this month are about the average, and we shall soon see another spurt made by the small miscellaneous producers. Mean-

RAILWAY ACCIDENT AT ACCRINGTON



time, we find that the consumption of copper in the United Kingdom for the nine months to September 30th is 23 per cent. below that of the same period of 1898. The American production in the nine months has been 191,222 tons, against 174,811 tons; while the exports have not exceeded 79,541 tons, against 103,142 tons, and there have been imports amounting to 25,759 tons, against 5180 tons. The apparent consumption by this showing is 137,440 tons, compared with 76,849 tons last year. We submit that the measure of the increase—over 60,000 tons—is greater than the measure of the increased activity in manufacture.

MOTOR CARS AT THE PARIS EXHIBITION.

WHEN the Paris Exhibition authorities first distributed the space for the various classes of exhibits they caused a great deal of disappointment among motor car firms by classing the mechanical vehicles with ordinary carriages and relegating them to the annexe at Vincennes. The motor car movement has, however, been growing so considerably of late in France that it is now proposed to give special prominence to the new vehicle by laying out tracks and organising trials at Vincennes, and a committee under the presidency of M. Forestier, chief engineer of the Ponts et Chaussées, is now engaged in drawing up the programme. There will be four trials, that is to say, heavy motor cars with a tare up to 1200 kilos., cab and delivery vans of 500 kilos., private carriages, and light cars of the "voiturette" type. There will also be trials of speed indicators, overhead trolleys, and pneumatic tires. An electric generating station will be established at Vincennes for the recharging of the batteries of electric cabs taking part in the trials. Of the two million francs which will be devoted to the Vincennes annexe, about 100,000f. will be placed at the disposal of the Automobile Club de France for laying out the tracks and making the courses with heavy gradients and obstacles, so that the trials will be carried out under the same conditions as those on the ordinary road. Visitors will be able to watch the progress of the trials by means of model cars which will be moved electrically on a large board. In this and other ways it is intended to make the motor section the most interesting in the Vincennes annexe.

THE OUTLOOK IN THE COAL TRADE.

Is there going to be trouble in the coalfield? We think not. Appearances, we admit, are not promising. The miners' leaders, ignoring the bitter lessons of past experience, seem disposed to push matters to extremes. Having just succeeded in securing the 2½ per cent. advance under terms of the Rosebery arrangement, it is generally admitted, even by their own friends, that they are a little premature in putting forward the fresh demand for 5 per cent. extra, to date from January 1st of next year. Still, although the coalowners will be justified in requiring the miners' leaders to be reasonable, and to give due weight to considerations which at present they absolutely ignore—such considerations, for example, as the enormously increased cost of bringing coal to bank, and the disposition of the men to use their advanced wages more to "play" than to work—there is no fear entertained that the issue will be one of trouble in the mining industry. The coalowners, it must be confessed, have not been slow to follow the old principle of making the public pay. Coal has steadily gone up in price, with every indication that it will go still higher. It may be safely assumed that whoever suffer in the upward trend of values it will neither be the coalowner nor the coalgetter. The British householder has been so long accustomed to be ground between the upper and the nether millstone of the colliery proprietor and the coal-miner, that he is now used to the process and takes his punishment without flinching. He will have to do so again. In house coal, although winter prices have ruled all the year, what is called "the usual advance in October," which was in reality an extra advance, has been quite easily secured, and those householders who have not supplied themselves with coal for the winter had better do so now, for a further advance is certain in November. All these things, though they do not make for the interest of the consumer, make for peace in the coalfield. House coal by no means covers one-half of the output of the British coalfield, for if one quality of coal advances, the other does not lag behind, and Mr. Pickard is quite correct in saying that engine fuel and small coal generally are at values which are abnormally high compared with what they were a year ago. Steam coal, too, notwithstanding the falling away of the export trade through the closing of the Baltic ports, maintains a very high price, and, looking all round, the state of the coal trade is too prosperous to admit of the colliery proprietors making a stand even

against this sharp demand of the miners' officials for another 5 per cent. This 5 per cent. will bring miners' wages at a single bound up to the maximum value stipulated for under the Rosebery arrangement. And here comes the point of the coalowners. There is talk of compromise as to the amount. It is scarcely likely to come off. What the coalowners will most probably stand out for is some guarantee of peace in their industry by an extension of the time for which the Board of Conciliation was established. That period expires in a few months, and coalowners taking a broad view of the whole situation, particularly as the coal trade affects the entire industries of the country, think it reasonable, not merely that the period should be extended, but that it should be for a time adequate to "steady" trade in the future. Several colliery owners suggest that the minimum time of the extension should be five years, and others that it should be seven years. That it should be extended all are agreed. If the miner is wise he will take care now to husband his resources, and instead of "playing" on the slightest provocation, and making holiday whenever he has the chance, he will take care to take home as much as he can at the week-end, spend as little as is compatible with comfort and reasonable recreation, and lay up what will keep him in the days when the clouds once more fall upon his industry, as they are certain to do.

A REMARKABLE ACCIDENT.

THE engine shown in the engraving above, which we reproduce from a photograph by Mr. A. Greenwood, photographer, Accrington, was shunting at Accrington at midnight, September 26th, and when coming out of the sidings on to the main line, the signalman by mistake so set the points that the engine ran into the buffer stops at the end of the siding, carrying them away and falling into the street, a distance of 18ft. Very little damage was done to the engine, which was one of Mr. Aspinall's standard goods type.

ROYAL YACHT.—The new Royal yacht Victoria and Albert will be undocked at Pembroke Dockyard on November 18th, instead of December 6th, as was previously intended. The engines will then be subjected to a series of trials, which will probably occupy a fortnight. If the result is satisfactory, the ship will immediately thereafter proceed to Portsmouth to be completed. The new arrangement is the result of a recent visit of Sir William White, Director of Naval Construction, and the order directing it to be carried out was received at Pembroke Dockyard Wednesday. A full description with illustrations, of this yacht, was given at the time of its launch.

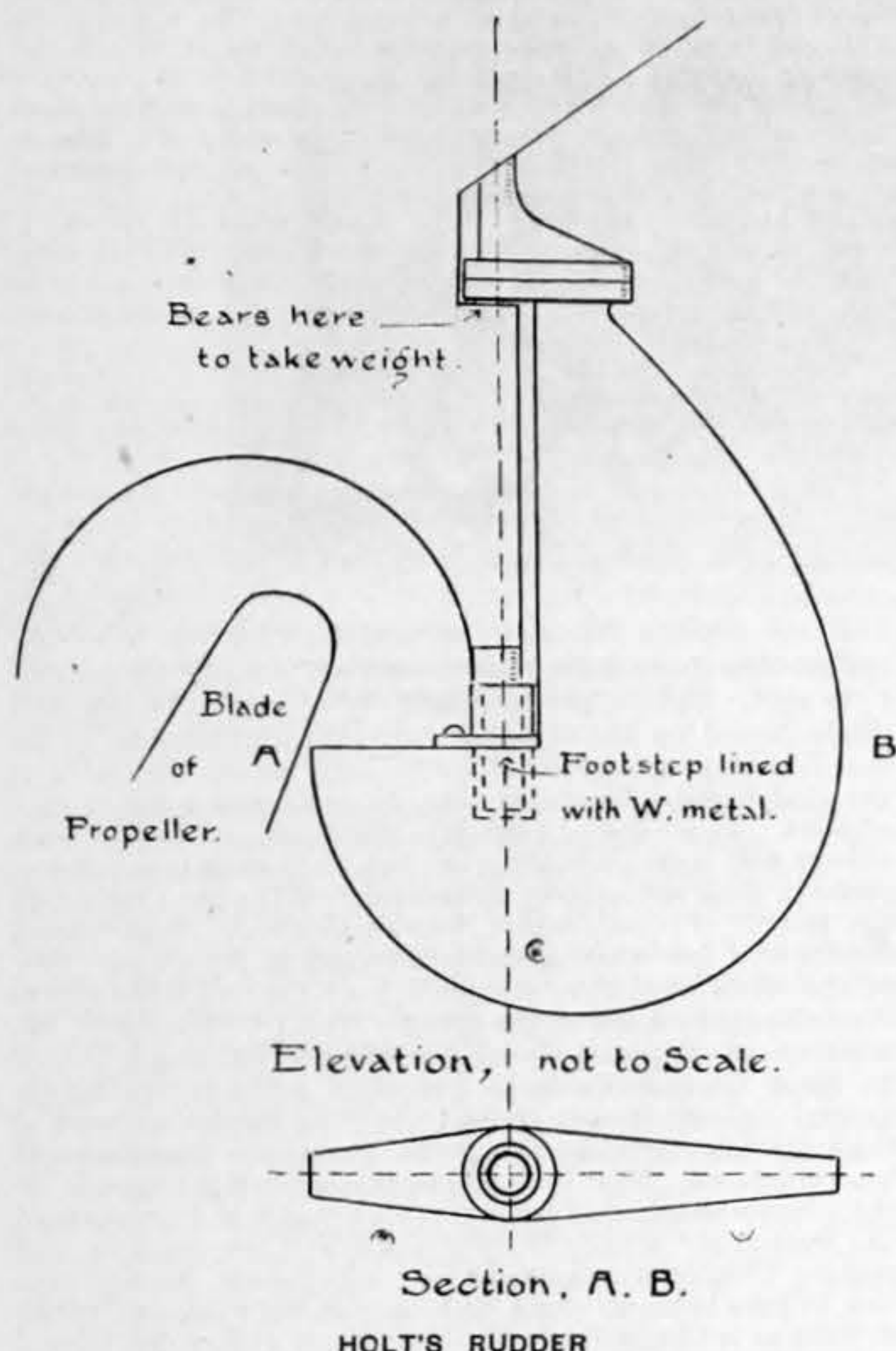
THE SHIPBUILDING INDUSTRY.—Taking the Scotch, English, and Irish figures together, we estimate the total output of new vessels in the United Kingdom for the three quarters ending September 30th last at about 1,100,000 tons. This, if correct, will compare with about 1,000,000 tons in 1898 and with 750,000 tons in 1897. The work remaining on hand is nearly twice as much, according to Lloyd's tables; but these, as we have said, include several vessels which, although not completed, have been actually launched. In so far as these are concerned the work is truly "on hand," but not in quite the same sense as the new bookings we record as providing work for the future. With these qualifications we extract from Lloyd's tables the following:—

	Sept., 1899.		Sept., 1898.	
	No.	Tonnage	No.	Tonnage
Merchant steamers	588	1,342,385	572	1,361,557
Do. sailors	25	5,164	26	2,698
Total	558	1,347,549	598	1,364,250
Warships:—				
British	52	331,370		
Foreign	30	81,680		
Total work on hand in shipyards of United Kingdom ..	640	1,760,529		

This includes 125,920 tons in the Royal dockyards, but does not include vessels under 100 tons in the private yards. Of the total of merchant vessels, 425, aggregating 1,095,944 tons are for British owners. The largest tonnages building for foreign countries are 67,870 tons for Germany, 34,600 tons for Holland, 27,290 tons for Austria-Hungary, 17,452 tons for Norway, and 16,600 tons for France. It is significant that we are now building only 800 tons of merchant shipping for Japan, whose orders in past recent years have been so extensive, but who now aims at building all her own ships. With such a volume of work on hand in the shipyards, practically all requiring engineering—apart from repair work and the new contracts in treaty or in prospect—it seems probable that the demand for structural material in iron, steel, and copper, will be as great next year as this, if not greater. What the war in South Africa may imply for the iron trade it is yet too early to forecast.—*The Statist.*

BALANCE RUDDER, S.S. STENTOR.

SOME of the vessels recently built by Workman, Clarke, and Co., Limited, of Belfast, for the Ocean Steamship Company, of Liverpool, managed by Mr. Alfred Holt, have a very peculiar form of stern in the way of the screw aperture, and a no less peculiar arrangement of balanced rudder. The accompanying engraving—which is not drawn to scale—gives a general idea of the form of one of these, the s.s. Stentor, at this part. The weight of the rudder, except that portion which is water-borne, is taken at the top of the tube-shaped after-part of the vessel, as shown by the sketch. The stern plating at this part ends in a steel tube, 18in. in diameter, which makes it sufficiently accessible for riveting. The rudder is constructed with plates and angles, and



is coupled at the top to the forged head. It works with a pintle at the heel, having a gun-metal bush turning in a cavity lined with white metal. It is understood that the arrangement gives complete satisfaction.

THE LUBRICATING OILS OF DIFFERENT COUNTRIES.

THE characteristics of a good lubricant are not altogether easily defined, and it is not too much to say that few of those who have the lubrication of an engine to attend to thoroughly understand their work. The popular idea of lubricating the parts of any mechanism is to drop a sufficient quantity of oil into the openings provided for the purpose, and the engine will run smoothly. This is by no means the only function of the lubricant, as there is as much waste of power caused by imperfect lubrication. Therefore, the choice of a lubricant suitable for its special purpose and the manner in which it is used, becomes more than a rule-of-thumb affair—it becomes a study. It is a generally accepted principle that the viscosity of the lubricant should be in proportion to the pressure sustained—that is, the lubricant should be just sufficiently viscous to keep the moving surfaces apart. This, of course, involves a differentiation in the constituency of the lubricant according to circumstances, or proportionately to the pressures involved. A slight variation in the composition of the oils, a foreign ingredient, will, therefore, naturally considerably affect the efficiency of the lubricating power. Professor Thurston, in his work on "Friction and Lost Work in Machinery and Millwork," laid down the following characteristics of an efficient lubricant:—(1) Enough "body" or combined capillarity and viscosity to keep the surfaces, between which it is interposed, from coming in contact under maximum pressure. (2) The greatest fluidity consistent with the preceding requirement, i.e., the least fluid friction allowable. (3) The lowest possible coefficient of friction under the conditions of actual use, i.e., the sum of the components, solid and fluid friction, should be a minimum. (4) A maximum capacity for receiving, storing, transmitting, and carrying away heat. (5) Freedom from tendency to decompose, or to change in composition or otherwise, on exposure to the air or while in use. (6) Entire absence of acid or other properties liable to produce injury of materials or metals with which they may be brought in contact. (7) A high temperature of vaporisation, and a low temperature of solidification. (8) Special adaptation to the conditions as to speed and pressure of rubbing surfaces under which the unguent is to be used. (9) Freedom from grit and all foreign matter.

With the exception of items 1, 2, and 8, these conditions apply more to the manufacture of the lubricant, perhaps, than to its application. In regard to the first and second, it will be seen that the discrimination and knowledge of the user is called into service to a large extent; in fact, these two points, in conjunction with that expressed in No. 8, will prove the ability and scientific knowledge of the user. There is a wide diversity in the qualities of the oils lying between the two first desiderata; and it is more than probable that the exact suitability of the lubricant to its special duties is never gauged. What this means to a machine, to the resultant work, and to the economic conditions of production has already been pointed out. It was once thought that the specific gravity of an oil was the best test of its lubricating efficiency. Now it is recognised that the viscosity is the chief determining factor. The American oil is, perhaps, preferable

for lubricating purposes to the Russian oil. A comparison of lubricating oils from different countries follows:—

	Specific gravity.	Flash point °C.	Burning point °C.	Viscosity.			
				30°	50°	70°	100°
AMERICAN—							
For machinery .. . . .	.920	206	245	8.90	4.23	—	1.65
" spindles .. . . .	.908	200	240	6.46	3.32	—	1.61
" steam engine cylinders	.886	283	330	—	—	—	4.17
" " " " " "	.899	280	344	—	—	—	4.82
RUSSIAN—							
For machinery, locos., &c.	.920	185	212	—	13.84	—	2.42
" spindles .. . . .	.895	163	190	—	3.40	—	1.53
" steam engine cylinders	.911	218	267	—	10.44	5.67	2.15
" " " " " "	.923	208	235	—	—	8.26	2.88
" general purposes .. .	.908	188	170	—	8.84	—	2.05
GERMANY—							
For machinery, transmission gear, &c. . . . .	.928	155	193	—	15.48	—	2.69
" general lubricating purposes .. . . .	.921	152	195	—	4.55	—	1.60
" " " " " "	.994	135	168	—	3.17	—	1.40
BURMA—							
Lubricating oil	60° F. .920	Close.	Open.	—	—	70° F. 140° F.	34.23 9.24
	.931	336	360	—	—	124.02	15.71

From these data may be judged the various qualities of the lubricating oils produced and used in different countries. Special conditions are laid down in regard to the quality of the lubricant for use on the principal German railways. On the Royal Prussian railways the specific gravity of the oil at 20 deg. Cent. must lie between .900 and .925; the flash point must be 160 deg. Cent. The oil must be of two different descriptions, known as "winter" and "summer." The former must remain fluid at 15 deg. Cent., and the latter at 5 deg. Cent. It must be free from water and acid, have only a slight smell, and completely dissolve in petroleum benzine having a specific gravity of .67 to .70. Foreign substances, or a sediment, even after long standing, are not permitted, and it must not resinify or dry to a varnish stratum on long exposure to the action of the air; and the addition of mineral oils, or distillation products thereof, to rape oil is strictly prohibited in the districts of Altona and Berlin.

The restrictions placed on the supply of lubricating oil to the Baden State Railway include that the mineral lubricating oil must be prepared only from petroleum, and must not contain any other description of oil of vegetable or animal origin. A very small proportion of solid hydrocarbons is permissible, and the oil must be quite free from gum-like impurities. The colour must not be too dark, and the oil must be transparent in thin layers; the presence of solid matter, and any sedimentation after prolonged standing, are disallowed. At 15 deg. Cent. the specific gravity must lie between .890 and .940. On distillation not more than 10 per cent. by volume should come over below 300 deg. Cent., and not more than 7 per cent. by volume must remain of undistillable residue. The flash point must not be below 160 deg. Cent., nor the burning point below 190 deg. Cent. Viscosity must be equal to that of rape oil at temperatures up to 50 deg. Cent.; at 5 deg. Cent. the oil must be fluid, and not exhibit any separation of solid matter. Different regulations are laid down for the lubricant to be used on the Bavarian State Railways. The oil must be odourless and free from tar, oil, &c.; specific gravity varying between .910 and .920; flash point, 190 deg., with a margin of 10 deg. either way; viscosity at 50 deg. Cent. of 230 to 330, taking rape oil at 100. The viscosity must diminish slowly between 20 deg. Cent. and 150 deg. Cent., and the viscosity of summer oil must be relatively higher, and the winter relatively lower, between these figures. These instances exhibit pretty well the great care that is taken in choosing a lubricant for railway purposes. But the choice of an efficient lubricant is not the whole process. Its wise and judicious application is as of great importance as its choice, and unless the different duties of various parts of a machine or an engine are carefully and scientifically studied, the best lubricant will be wasted, and its inherent efficiency made of no avail.

CLYDE SHIPBUILDING.

CLYDE shipbuilders, during the nine months of the year now passed, have launched and shipped abroad in pieces new shipping to the amount of about 335,000 tons gross register, this being the highest nine months' aggregate ever reached throughout the history of the industry. The previously highest output for a corresponding period was 293,000 tons, which figure was reached in 1883. The following are the output figures for the several months of this year:—January, 31,650 tons; February, 25,550 tons; March, 53,360 tons; April, 34,360 tons; May, 52,140 tons; June, 36,100 tons; July, 19,850 tons; August, 36,750 tons; September, 44,520 tons; the average monthly figure being 37,160 tons. It is estimated that the work on hand and under contract at the present time amounts to 460,000 tons gross, as compared with about 480,000 at the same date last year, and 366,000 tons the year previous. As a considerable amount of the work in progress is in a very forward state, the output for the present year should be by far the greatest in the history of the industry. As indicating the important character of much of the work overtaken during the nine months, it may be stated that of the vessels launched three were over 10,000 tons gross register—one, the Japanese battleship Ashai, being of 15,000 tons displacement; one was between 9000 and 10,000 tons; two were between 8000 and 9000 tons; one between 7000 and 8000 tons; three between 6000 and 7000 tons; six between 5000 and 6000 tons; nine between 4000 and 5000 tons; thirty between 3000 and 4000 tons; nine between 2000 and 3000 tons; and twenty-eight between 1500 and 2000 tons. Of individual vessels of note, it is sufficient simply to recall the twin-screw Bavarian, 10,200 tons, built by Denny and Brothers for the Allan Line; the twin-screw steamers Kinfauns and Kildonan Castles, each of about 10,000 tons, built by the Fairfield Company for Donald Currie and Co.'s Cape mail fleet; the Montezuma, 8000 tons, built by A. Stephen and Sons for Elder, Dempster, and Co.; the Paparua, 8000 tons, built by Denny and Brothers for the New Zealand Shipping Company; the Bethania, 7800 tons, built by Stephen and Son for the Hamburg-American Line; the Ismore, 6250 tons, for Bates and Son, Liverpool; the Calchas and the Machaon, each of 6700 tons, built by Scott and Co. for the Ocean Steamship Company; and the Tagus and Trent, each of 5500 tons, built by R. Napier and Sons for the Royal Mail Steam Packet Company. The contracts for new work booked during the past four months—all the important contracts for naval work having been secured prior to that time—have averaged 24,000 tons per month; and this is making full allowance for the flagrant redundancy with which irresponsible reports in the daily Press credit builders. Amongst the more important bookings which have taken place during the period named, the following may be enumerated:—The Fairfield Company is commissioned by the India-office to build and engine a large troop ship, 420ft. in length, and of 18 knots speed; Denny Brothers, Dumbarton, are to build and engine a twin-screw steamer of about 8000 tons for the New Zealand Shipping Company; Caird and Company, Greenock, a steamer of 6000 tons for the Peninsular and Oriental Company; William Hamilton and Co.,

Port Glasgow, a steamer of 7000 tons deadweight capacity; D. and W. Henderson Partick, two steamers of 4500 tons for the Anchor Line.

With further reference to the careless repetition of new orders in the daily Press above mentioned, it has been represented to us by shipbuilders themselves that this matter—one to which we have before now called attention—is becoming more and more annoying and detrimental to the conduct of business. It is, of course, natural, and doubtless quite right, that note should be taken of fresh work for our industrial centres. Individual firms, however, feel that the kind, even more than the degree, of attention directed to the contracts they secure is far from being either agreeable or beneficial. Thus the announcements about contracts are doubled and even trebled, and the actual amount of tonnage booked is greatly magnified, which is scarcely so flattering a compliment as, perhaps, the irresponsible authors of it intend. Here is the sort of process, as outlined by one of the aggrieved builders: "A contract for a large steamer is first of all announced as having been booked by a certain firm of builders; then we hear, in the same well-informed medium, of a certain shipping company having placed the order for a large steamer with a Clyde firm; and anon we are informed, with all the impressment of a fresh 'item,' that Messrs. So-and-So, shipbuilders, have been instructed to build a large steamer to be classed in, and built under the special survey of, such-and-such a Registry of Shipping." All these variously worded announcements refer to the same vessel, and the stupid redundancy which thus goes on interminably, in busy times especially, is responsible for grossly exaggerating the amount of tonnage actually ordered, and misrepresenting the industrial situation entirely. This in turn engenders wholly unwarranted unrest as to wages, and not only so, but leads to the unsteady and idly-inclined workmen losing more working time than they otherwise would; and this, in all conscience, has been bad enough ever since the institution—four months and a-half ago, on a twelvemonth's trial—of the weekly pay system.

CATALOGUES.

British Thompson-Houston Company, Limited. Pamphlet No. 6. Slow and moderate speed motors, type M.P.
Bullock Electric Manufacturing Company, Cincinnati, U.S.A. Direct-current multipolar motors. Type N.
Lawton and Parker, Ardwick, Manchester.—This little brochure is devoted to a treatise on "Modern Gas Engines," with hints to users as to construction and selection.
Webster and Bennett, Coventry. Supplementary catalogue and price list of machine tools.—This little book contains some excellent examples of brass finishers' and capstan lathes. The illustrations are good examples of the wood engravers' art.
Frederick Nell, Queen Victoria-street, London. Smith Vaile pumping machinery, condensers, compressors, and centrifugal pumps.—This book is arranged in sections and well indexed. With the additional information contained it forms quite a useful treatise on pumps, and will repay perusal by persons interested.

THE GERMANIC IN A COLLISION.—About three o'clock on Wednesday morning a collision occurred in the Mersey, owing to a thick fog. The White Star liner Germanic, due to leave for New York that afternoon, was coming out of dock to take up her anchorage and get her passengers on board. She had just cleared the dock entrance, and was lying across the river, when a steam hopper barge ran into her port quarter, making a hole 12ft. square. The vessels remained locked together for some time, and on their getting clear it was seen the Germanic had sustained serious damage. Her captain decided to return to dock immediately, and the Germanic will not leave for this voyage. The hopper was able to continue her course.

DEATH OF MR. S. B. ALLPORT.—We record with regret the death from pneumonia of the highly respected Master of the Birmingham Gun proof-house—Mr. S. B. Allport—which occurred on Tuesday, at his residence, Pymore, Moseley, in his seventy-seventh year. Mr. Allport was one of the oldest members of the Birmingham gun trade, his apprenticeship to his father dating from the year 1836. He brought an exceptional amount of intelligence to his work even in his early years, and on coming of age turned his attention to civil engineering. During the next ten years he superintended various classes of contracts, including docks, waterworks, and railways. Family circumstances, however, induced him to return to the gun trade and take up his father's business at his death in the year 1858. He considerably developed it in the following thirty-five years, and rapidly took a leading place for excellency of the work turned out. Mr. Allport was elected a guardian of the Birmingham Proof-house in 1867, and so continued until 1892, when his manufactory was absorbed for part of the site of a new hospital then about to be erected. Thereupon the Proof-house Guardians invited him to become Proof-master, and this position he retained until his death. He designed a testing apparatus consisting of models of rifle and shot gun barrels of different types, furnished with crusher gauges at intervals. One valuable series of tests conducted by him related to the relative endurance of Belgian and English barrels. Mr. Allport, as is evident from our account of his career, was strongly impressed with the importance of the scientific aspect of gun-making, and the part which modern machinery may be made to play in developing and extending the trade.

LIGHTING AND HEATING THE NEW CUNARD LINER INVERNIA.—W. C. Martin and Co., electrical engineers, Glasgow, have secured the contract to fit the large Cunard liner Invernia, launched from the shipbuilding yard of Swan and Hunter, Limited, Wallsend-on-Tyne, on the 21st ult., with electrical plant for lighting and power. The electric lighting of the vessel is to be on a very extensive scale, the plant consisting of two compound engines coupled direct to two dynamos, each set capable of supplying current to light 1500 eight-candle power lamps. A powerful search-light giving 20,000 candle power is to be fitted at the bow of the steamer for navigating purposes, and a thorough system of heating and ventilating all the rooms, machinery, and cargo spaces will be installed. Ten three brake horse-power electric motors and ten 30in. fans driven direct will be fitted, five of the fans to drive cold air through Stewart's patent thermo-tank heated by steam, when the air will be heated to a certain temperature, and then carried into each room by ventilating tanks. The other five fans will exhaust the foul air from the holds at the rate of 12,000 cubic feet per minute. Electric motors will also be used for driving the hair brushes in the barber's shop and for other purposes throughout the steamer. The Stewart system of thermo-tank ventilation above referred to is intended to obviate, as far as possible, the various objections to the ordinary system of steam-heating generally in use on board ship, and it has been already adopted in a number of large passenger-carrying steamers, notably in two built for the Russian volunteer fleet, by the Clydebank Shipbuilding Company. The system combines a satisfactory ventilating system with an improved arrangement of heating. An efficient form of heater is combined with a steam or electrically-driven fan, and placed on deck or outside the compartments to be heated and ventilated. This heater is connected to the ventilating trunk through the compartments and rooms, and any required volume of air at any required temperature can be delivered to the compartments. By a suitable arrangement of valves on the connections to and from the thermo-tank, air may be exhausted from the compartments to the atmosphere, or may be circulated in the compartments through the heater, thereby raising the temperature very rapidly, and it may also be delivered direct into the ventilating trunks without passing through the heater.

LETTERS TO THE EDITOR.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ELECTRIC LIGHTING AND REFUSE DESTRUCTION.

SIR.—Will you permit me, in reply to your correspondent Mr. Alliot, first to assure him that it is far from my intention to disparage the Shoreditch combined installation, or to deprecate the adoption of such schemes in other districts? On the contrary, I am a strong advocate of undertakings of this nature, but I regard a destructor primarily as a sanitary means of disposing of refuse rather than one of generating steam for large installations. There has been so much exaggeration concerning the particular works in question that it seems highly desirable that the exact financial position after two years' working should be stated. Now, it seems to me that although Mr. Alliot disagrees with you on some points, yet his figures only tend to confirm the views expressed in your article as to the net results down to the present time.

A comparison is given by Mr. Alliot between the charges for current in Shoreditch and the City and Clerkenwell, and he states that an addition of 40 per cent. to the price in the former case would increase the revenue by £4000, and make a wonderful difference in the balance-sheet. I quite agree, providing that the same number of units were sold. But surely your correspondent does not wish to convey the idea that if the higher charges of 40 per cent. or 50 per cent. obtaining in the City had prevailed in Shoreditch, the consumption would have reached the 1,031,348 units revealed in the balance-sheet? I am afraid that if City prices had been charged in Shoreditch, the number of consumers would not only have been considerably fewer than at present, but also that the units sold would have been so much less that, instead of an addition to the revenue of £4000, it is probable that the total receipts would have been curtailed by that amount. The development of electric lighting in Shoreditch is entirely due to the low charges for current, and if high prices had been maintained, the ratepayers in a district of that character would not have so largely availed themselves of the supply. Hence one must deal with things as they are, and not with supposable figures in comparison with adjoining districts.

The reference to the *Municipal Journal* seems to me somewhat unjudicious. I cannot regard that journal as an impartial or competent critic on the question at issue, and I should be loth to believe that your correspondent can seriously do so. But even assuming as correct the assertion that 750,000 units were generated from the heat of the parish refuse alone, and that the value of the steam produced was £3660, or slightly more than the deficit of £3616 on the destructor, this in no way affects the net financial results of the combined undertaking. If the destructor is credited with £3660 for steam supplied to the electric lighting installation, the latter must be debited with that sum, so that instead of showing a surplus of £5882, the profit is immediately reduced to £2222. It is merely a question of account, although an important one in so far as the destructor is concerned, since the deficit of £3616 is converted into a surplus of £44. At the same time, I do not know the source, other than that quoted by your correspondent, for the assertion that 750,000 units were produced from the incineration of the parish refuse. The statement does not appear, so far as I can see, in the accounts, and Mr. Newton Russell, the chief engineer, recently informed me that he was unable to amplify the figures until the balance-sheet had been discussed by the Vestry. That discussion has not yet taken place, although it will probably be over by the time these lines are in type.

With regard to the remark that the £3660 to be credited to the destructor for steam supplied to the lighting department does not show the total advantage to the parish arising from the destructor, I am sorry to find Mr. Alliot again relying for his information upon the journal already mentioned. He states that in addition to the £2372 credited to the destructor for disposing of the refuse, if the latter had been barged away as formerly a further saving of £1186 would have been obtained. For the moment I am reluctant to accept the latter statement as being accurate. I may say on the authority of Mr. Freeman, the then chairman of the Shoreditch Plant and Scavenging Committee, that during the first year's working of the electrical installation the cost of disposing of the parish refuse exceeded that of the previous year by £1500, and if your correspondent desires further information on this point he will find it in the *Electrical Review* of November 13th, 1898. If, then, an extra expenditure of £1500 was incurred in 1897-98 with 18,280 tons of refuse, is it likely that when dealing with the larger quantity of 23,728 tons in 1898-99, an economy of £1186 would be realised? As, however, information on this point will soon be available it will be unnecessary for me to refer further to the suggestion that the undertaking appears to have benefited last year by £1200 by the use of a destructor, since this sum is practically the same as the £1186 said to have been economised by incineration instead of by barging—a point upon which, in addition to that of steam supplied to the baths, no trustworthy data are forthcoming at the present moment.

To sum up the whole question, it appears to me that Mr. Alliot has made out a good case for the combination of a refuse destructor with electric lighting works; but leaving out of consideration the two debatable points referred to, he has failed to alter the net results of the installation considered as a joint undertaking. He merely converts the deficit of £3616 on the destructor into a gain of £3660 on the electric plant, or a surplus of £44. Then, if the lighting station is debited, as it must be, with the £3660 for the steam supplied, the profit of £5882 on the latter becomes reduced to £2022, instead of £2036 as stated in your article, and this balance would probably be wiped out if depreciation of plant and machinery had been provided for, as it would in any well-conducted engineering undertaking.

I have no doubt that in the future the Shoreditch installation will become a commercial success, but the experience of the past two years shows how inadvisable it is to be too enthusiastic in these matters, and it is to this excess of enthusiasm that I attribute the tardy extension of refuse destructors throughout the country.
Chelsea, October 21st. T. W. A.

SIR.—Mr. Alliot's letter is interesting. His firm have fitted up so many destructors, that he probably knows as much about their construction and working as anyone. May I ask him, if he has the facts, to tell us what ought to be allowed for depreciation of the plant?

I have had a fairly extended experience of furnace work, and I am certain that 25 per cent. is a very moderate estimate indeed to allow for this most important item. So far, destructors being new, very little has been said about this; but once repairs begin, the various corporations using destructors will have their eyes opened, I fancy. But what we want are facts and not speculation. No balance-sheet, however, is of the least value unless it contains this item.

Your correspondent "Old Jewry" does not attach too much importance to the thermal storage question. Why was not Halpin's system applied at Shoreditch?
Port St. Mary, October 21st. T. EVANS.

BRITISH ASSOCIATION SCREW GAUGES.

SIR.—Your correspondent "X." has been singularly fortunate in his choice of a *nom de plume*, as this subject of the British Association screw sets is evidently to him a quite "unknown quantity." His reference to Nettlefolds shows his total ignorance of the whole question, as that eminent firm's business does not depend on the making of gauges, dies, or taps. Possibly, however, your correspondent thinks the British Association screws are used for hanging pictures, and hence his reference to "objects of art."

The making of a few screw gauges by the Pratt and Whitney Company is admittedly, in itself, a small matter. But a straw will show how the wind blows and "ilka little makes a muckle." "X." could not bring forward any reason why these gauges were better made by the American firm than by our British firms, and so contented himself with blackguarding his opponent. If indeed it is such as the writer who degrades our country's work and workers, what has "X." to say about our great and illustrious countryman Sir Joseph Whitworth, who was the first to awake the world to the necessity of standard screws, and who took every available opportunity of impressing upon every one connected with the mechanical arts that upon the accuracy of their work and the standardising of parts depended our national existence? When president of the Institution of Mechanical Engineers he delivered his presidential address at Glasgow in 1856—over forty years ago—and in this address he called the special attention of his audience to the vast importance of attending to the two great elements in constructive mechanics, namely "a true plane and the power of measurement." And in this same address, in speaking of the proper gradations of size in all the various branches of the mechanical arts, he used these words, viz.:—"Our friends across the Atlantic manage matters in this connection much better than at present we do."

So that even forty years ago it was recognised by the man who probably knew more than any man living about accuracy of measurement and standardising of parts that our cousins were ahead of us. If your correspondent "X." composes his mind long enough to consider who are at the present time the recognised leaders in the making of standard gauges, micrometers and such like; and then, instead of writing about wood screws or lamenting the deplorable state of your other correspondents, give us some proof that there are firms in this country as well equipped as the Brown and Sharpe or the Pratt and Whitney companies for undertaking standardising work, he will be doing something towards the end which we should all work for—namely, the awaking of the British toolmaker to the fact that our competitors in the United States are not to be despised. So long, however, as our manufacturers follow the lines laid down by your correspondent "X." so long will we continue to let other nations make up on us. I venture to assert that had the making of standard sets of screw gauges been asked for during the lifetime of Sir Joseph Whitworth the efforts of the Committee, as described in a letter by one of the members in your issue of the 29th September, would have had a different result.
ICHABOD.

London, 17th October.

ENGLISH AND AMERICAN RAILWAYS.

SIR.—In the editorial on "English and American Railways," in THE ENGINEER of September 15th, you say that the United States people built long box cars with seats because the mail coach was practically unknown, and also that the climate rendered covered cars imperative. Historical facts do not substantiate these statements. Many of the earliest passenger cars were simply coach bodies mounted on four-wheeled platform wagons, while other roads used open cars, in which passengers were blackened by smoke, burnt by sparks, and incommoded by wind and rain. The coach-body cars on the Mohawk and Hudson Railroad—which are still in existence—were built and hung, as the original specifications say, "in the style of workmanship generally adopted in Albany and Troy for post coaches." The bodies were 7ft. 4in. long and 5ft. wide in the centre, with three inside seats, an outside seat at each end, and a seat at each end "for driver or brakeman." Other railways used similar cars, but in later years the size was increased. The Baltimore and Ohio Railroad used such cars at first, but the increase in speed with the introduction of steam traction made a greater length desirable, and in 1833 Mr. Winans constructed long cars on bogie trucks. In 1834 and 1836 such cars were in use, 30ft. to 40ft. long, with transverse seats, having reversible backs and central aisles, as in American cars to-day.

I do not understand why you call the modern American car a "Pullman" car, as Mr. Pullman in no way originated the type. He was not even the first inventor of the sleeping car, but pushed the business more vigorously than his predecessors. He began his experiments in 1859, ran his first sleeping car in 1864, and organised the Pullman Palace Car Company in 1867. This company builds all kinds of passenger, goods, and tram cars, but operates only sleeping, dining, and parlour cars. Some sleeping cars have compartments opening off from side corridors, these being on the "Mann" patents, acquired by the Pullman Company. The standard American passenger car of to-day has two rows of transverse seats, separated by a central aisle, and having reversible backs. There is a window to each seat, a drinking water-tank, steam heat, and one or two toilet-rooms.

These remarks are made not as criticisms upon your article, but in order to correct certain points. For my own part, after considerable experience with compartment cars and corridor cars in Europe, and the American type of car in this country, I most decidedly prefer the latter, and should prefer it for a journey of twenty-five to fifty miles as well as for one of 100 to 1000 miles. For the great distances, however, one would naturally take a sleeping car.

In regard to your comparison of English and American systems of operation, you omit to state that since American railways, with the highly economical working which has been introduced of late years, can only make small returns, they would be bankrupted under the old methods of working, combined with present freight rates. Still more would they be bankrupted if operated under English conditions. It must be remembered that our freight rates now range from a farthing to a halfpenny per ton per mile, and seem likely to go even lower.

I believe that English railways might introduce important economies by following the American practice of carrying bulk freight—such as coal and ore—in large car loads and large train loads. The objection always made to this is that turntables, shipping docks, &c., are too small for large cars, but a little study of economics will often show that it is real economy to make heavy expenditures in order to secure permanent reductions in cost of operation. It is easy to say offhand that it cannot be done. It would be wiser to investigate, and having found that it can be done, to go further and see if it will pay to do it.

This is the case on many American railways, where enormous sums are being expended to improve the gradients and curves, to replace trestles and timber bridges with permanent structures, and to provide larger cars and more powerful locomotives. The improvement of the line and the new rolling stock enable heavier trains to be hauled with greater economy, and also reduce the cost of operation. The permanent structures also materially reduce the cost of maintenance. In fact, under the steady decline of rates, due to competition, to adverse legislation, and to public clamour, it has become imperatively necessary to introduce these economies in operation if the railways are to be kept out of practical bankruptcy.

If you compare American railways under conditions similar to those of English railways, instead of making a broad average for the 185,000 miles of American railways of all kinds—including prairie and pioneer lines—the results will be more fair and more useful. The results will also show less discrepancy between English and American lines, since many which are properly comparable with English lines pay 4 to 8 per cent. on the stock and bonds.
E. E. RUSSELL TRATMAN.
Chicago, Ill., October 10th.

ENGINES WITH DIRECT-CONNECTED DYNAMOS.

SIR.—In reference to Mr. Woolford's letter in your issue of the 20th inst., I fully appreciate the causes he mentions of unequal loads on engines for electric traction, but the point I wished to draw attention to was that it is most improbable, though not impossible, for the load on an engine supplying current to a large

number of cars to change from no load to full load three or four times a minute.

Take the case of 100 cars on ordinary street service, I think it unlikely that every one of these will be at rest together three or four times a minute, and wherever I have watched the ammeter in a power station supplying current to a large number of cars, there has always remained some of the load on the engines. That a traction load is usually very variable everyone must admit, but I think the statement I have just referred to exaggerates the case.

Turning to the fly-wheel, I have to confess myself unable to follow Mr. Woolford's explanation of how a heavy fly-wheel lessens the stresses on a crank shaft. To prevent misunderstanding, I may say that I have in mind an engine of what might be termed the standard American slow-speed type, having the fly-wheel and armature each keyed on to the crank shaft, which shaft runs in two bearings, the armature and fly-wheel being between the bearings.

In this case there is a turning moment on the shaft due to the work done on the engine pistons, and there is a resisting moment due to the current developed at the armature. The stress on the shaft may be measured from whichever is the greater of these two moments; normally, of course, the two should be equal, and it is the duty of the governor to so control the steam as to bring about this equality. Assume the governor to have for the moment effected this balance, and that the load is then suddenly switched off pending the governor again balancing matters, the surplus turning moment on the shaft will be mainly absorbed by the fly-wheel, an increase of speed resulting, the stress on the shaft being measured by the turning moment due to steam pressure, and this stress will not be materially affected whether the wheel is very heavy or only moderately so.

Taking now the case where the load is suddenly increased, then until the governor can balance the new conditions, the resisting moment is in excess of the turning moment, the balance being drawn from the fly-wheel.

If the armature and fly-wheel are keyed separately on to the shaft, the shaft stress will then be measured from the resisting moment at the armature. Here, again, the stress is not affected by any consideration as to whether the wheel is very heavy, or only moderately so.

If the fly-wheel is formed in the armature itself, or is so connected directly to it as to practically form a part of it, the transference of work between the armature rim and the fly-wheel would not go through the shaft. The importance of a good connection between armature and fly-wheel has been referred to in one of my earlier letters.

To my mind, the effect of an increase of fly-wheel weight is not to reduce stresses, but to reduce the speed variation which occurs in the periods during which the governor is lagging in its adjustment of the valve gear to suit the load; or, in other words, the heavier the fly-wheel the longer the time allowed for the governor to act to keep the speed variation within certain limits, this tending to simplify the governing problem. I have previously pointed out that increased fly-wheel weight means increased bending moments, and in this letter I have endeavoured to outline my reasons for thinking that it does not reduce torsional stresses. If neither the intensity nor the frequency of these stresses is reduced, then the shaft strength is not.

October 24th.

CHAS. DAY.

EMPLOYMENT FOR RESERVISTS.

SIR.—Referring to the announcement appearing in the Press, that an organisation is being formed with the object of finding employment for the wives and families of Reservists called out for service with the colours during the present trouble in South Africa, we should feel very grateful if you would allow us to use your columns for the purpose of intimating to the employers of labour throughout the kingdom that the War Employment Bureau is now open at 101, Fleet-street, London, E.C., for the purpose of collecting the names of firms who may be willing to give preference of employment to those applicants in the above-mentioned category in capacities which they are competent to fill, and at current rates of wages.

When this information is to hand, the names of firms co-operating will be duly communicated to the War-office, and Lord Wolsley has kindly said that as soon as we place him in a position to do so he will take steps to intimate to those concerned where they may apply for employment.

To make the scheme of real use to those whom it is desired to help, it is extremely desirable that, if possible, some employer-employers in every town in the kingdom should support it. To move families from one part of the kingdom to another, in order to place them in work, would be practically impossible, owing to the great expense involved. Moreover, one of the chief objects in view is to preserve the homes of those families whose breadwinners are maintaining the honour of the flag in South Africa; and therefore it is necessary that employment should be found for those who are in need of work, and are willing to work in the neighbourhood in which they at present reside. Lord Wolsley has pointed out that "anything which is to be done should be done quickly," and we trust that the necessity of prompt action will be considered sufficient justification by you for the step we are taking in asking your kind assistance in giving publicity to this letter, and also that the manufacturers and other large employers of labour throughout the kingdom, whom we are taking the liberty of addressing through your columns, will forgive this indirect way of approaching them.

A committee is now in process of formation, and as soon as possible an authorised prospectus of the War Employment Bureau will be circulated for general information, and in the meantime we shall be glad if employers willing to co-operate will communicate their names to us.

H. C. W. GIBSON, Joint Hon.

L. H. BENSON, Secretaries.

101, Fleet-street, London, E.C., October 23rd.

FRICITION OF COMPRESSED AIR IN PIPES.

SIR.—I want to convey air a distance of 3000ft. through 3in. pipes. The quantity of free air delivered by the compressor is 250 cubic feet per minute. The air is delivered into underground workings at a pressure of 10 lb. per square inch, as indicated by a pressure gauge fixed at the lock.

I wonder if any of your readers could tell me what ought I to expect to find the pressure to be per square inch in a receiver placed beside the compressor. In other words, what will the loss per square inch be in pressure owing to the friction in 3000ft. of 3in. pipe?

Kilkeel, Co. Down, October 19th.

J. M. F.

TOOL FOR FACING BRASSES.

SIR.—Some fifteen years ago, or it may be even more, you illustrated a small machine worked by hand, and suitable for a steamer's engine-room, for letting together brasses and such-like work. Its action was, I believe, after the manner of a shaping machine, and the idea was to secure greater accuracy than can be obtained by the file. Can you tell me when this appeared, and, if so, supply me with a copy?

October 17th.

HARRY T. SHAW.

[We have no recollection of this tool; perhaps some of our readers may be able to assist Mr. Shaw.—ED. E.]

THE Indian Government have sanctioned railway surveys for the coming cold season 1899-1900, amounting to 960 miles.

THE "VENTURI" WATER METER.

In our impression for August 27th, 1897, we gave a reprint of a paper read by Mr. Kent, of High Holborn, on the "Venturi" water meter, for which his firm are the agents and manufacturers in this country. An interesting modification of the original design to suit the meter for measuring water either way has been brought to our notice, but before describing it, it may be as well if we briefly remind our readers of the principle upon which it works. In the line of pipes through which it is desired to measure the flow of water are placed two taper pipes, of differing degrees of taper, joined together at their smaller ends. Now, as the rate of flow of water passing through the pipe increases, the lateral pressure diminishes at the point of contraction, according to Venturi's law. The result is that if two pipes be led, one to the water main before it has begun to contract, and another to the point of smallest diameter, and if these pipes be connected to either arm of a U-tube containing mercury, the level of the mercury will be interfered with in consequence of the difference in pressure. From the difference in level in the two arms of the tube the amount of water passing at any given time may be ascertained, and in the case of the "Venturi" meter this is done automatically. The accompanying illustrations will serve to make clear the foregoing description. It is only necessary to add that by an arrangement of counter and revolving drum and pencil, both the rate of flow at any moment can be known, and also the total amount of water which has passed.

The ordinary means of measuring water under pressure necessitate the use of mechanism placed in the line of flow, and itself actually operated by the water as it passes. The quantity of water passed is then deduced from the number of cycles of movement or of revolution of the mechanism. The "Venturi" meter does not interpose any moving part or obstruction to the flowing water, nor does it even produce

chambers with the recording apparatus in such a way that either main may be put into communication with it, and the amount of water passing be measured. This arrangement, it is said, involved no departures from the law which governs the action of the meter. To prove the truth of this, one of the water companies concerned conducted a series of tests some little while ago. These tests were made with a weir and recording gauge, which was proved against two 12in. "Uniform" meters, which had previously been checked against a gauged tank. The "Venturi" meter was tested against the "Uniform" meters and the weir, with the result that at three different rates of flow the maximum error was 0.92 per cent. slow, and the mean error 0.17 per cent. fast. Since then the results given by the "Venturi" meter, both by diagram and counter, have agreed within 1 per cent. with the computation of the weir recorder.

It would seem that the scope of this meter, as at present constructed, is practically limited to pipes of 9in. in diameter and upwards. The largest at present at work in this country are 48in. in diameter, though two of 90in. are under consideration. The limitation is towards the smaller sizes and not towards the larger. It arises, not from any incapacity of the smaller sizes to register accurately, but simply because of the comparative expense of the recording device for the

smaller sizes. This will readily be understood when we state that the price of the recorder is the same whether the diameter of the water main is 6in. or 60in.

Our illustration figure No. 2 is a reproduction of a photograph taken of the two-way measuring intercommunicating pipe between the systems of two London water companies. The "pressure" pipes coming from the two mains and from the throat are easily seen, and it will be noticed that they are of quite small diameter. We give also in Fig. 1 an illustration of the latest design of recorder.

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RUSSIA'S RAILWAY ACROSS PERSIA.

It looks as if there are very good grounds for believing that Russian engineers will at no very distant date commence the work of surveying the route for a Russian railway across Persia to the coast of the Persian Gulf. A member of the staff of the *Lokal-Anzeiger* has recently interviewed the Persian Minister at Berlin, and the latter expressed his view of the situation as follows:—

"The rumour of the projected railway is certainly founded on fact, although the details cannot as yet be stated, and there is nothing in the project that can give rise to any political complications. The proposal to construct a railway through Persia, from the Caspian Sea to the shores of the Persian Gulf, was made nearly thirty years ago. The concession for building this railway was made in 1872 to an Eng-

lish subject, Reuter. This concession referred to the stretch of country from Reshd, near the south-western shore of the Caspian Sea, and 150 miles north-west of Teheran, to Bushire, the principal port of Persia, on a sandy peninsula on the eastern shore of the Persian Gulf. Since, however, the terms of the concession were not fulfilled by Reuter, the concession has been declared to have lapsed. At a later period, about twenty years ago, the Russian Agent, General Falkenhagen, took steps to obtain an extension of the concession, but he could not at the moment get the necessary capital together. Some years ago, certain Russian contractors succeeded in obtaining this same concession. This concession was repeatedly renewed, but never carried out. As, however, the last extension of time that was granted will expire next year, it will be only natural if Russian engineers commence a survey of the district in question in order to proceed with the work of building the projected railway.

"This undertaking has nothing whatever to do with enlarging the Eastern Question, which is already of sufficient importance, for such a work is purely agricultural and for the good of civilisation. I can ascribe the errors and misconceptions to which the rumour has given rise, and which always will arise, entirely to the feeling of rivalry of Russia, which has now come to be a fixed idea in certain English circles. We have not the smallest premonitory signs for presuming that Russia's Asian policy is in any way directed towards disturbing the integrity and independence of Persia. We have loyal and sympathetic relations with both Russia and England, and—we are not afraid."

DOCKYARD NOTES.

THE French Minister of the Marine appears to be carrying out a compromise between the rival programmes of his predecessors. He is not only adding to the fleet of submarine boats and "commerce destroyers" so strenuously advocated by M. Lockroy, but is also adopting some of the suggestions of Admiral Besnard, who, as is well known, thinks that the safety of the country depends upon a strong line of first-class battleships. He has consequently decided to put two upon the stocks next year of about 15,000 tons. They will have a length of 133.80 m., a beam of 24.25 m., and a displacement of 14,865 tons. Each of them will have three propellers driven by triple-expansion engines developing 17,475-horse power. The maximum speed will be 18 knots. The coal bunkers will have a capacity of 905 tons, which will give a range of action of 930 miles at 18 knots; but this range can be increased to 1800 miles by carrying an additional supply of coal of 920 tons. The armament will comprise four guns of 305 mm. (12in.), eighteen of 164 mm. (6.45in.), twenty-six of 47 mm., and two of 37 mm., as well as five torpedo tubes. The equipment will be forty-two officers and 780 men. The estimated cost of each battleship is 35,542,700f.

NOTHING is happening at Portsmouth to justify the reports of naval preparations. The training squadron is, however, paying off, but opinions are divided as to whether this is coincidence or design.

THE Formidable has now got both her masts up; progress on the London is fairly rapid. The new armoured cruiser is not yet laid down; the slip for her at Portsmouth is being enlarged, and the entire topography of the yard behind the slip altered in consequence.

THE damaged Hunter, destroyer, has not yet been repaired, and she still lies in basin at Portsmouth with her bow twisted in the most extraordinary fashion. It is crumpled much as a top-hat that has been sat on—a homely simile, but the only one descriptive of the case.

Le Yacht this week has an article on Red Cross Ships, inspired, we cannot help thinking, by an article that appeared some while since in the *Naval and Military Record*. It is all very well in its way, but a hundred years ago ships to all intents and purposes Red Cross ships were employed. Well-intentioned laymen may formulate pretty schemes, but they invariably omit the two governing factors—(1) that modern ships are extremely unlikely to be sunk, and (2) that no admiral in his senses would permit a neutral vessel to dog his movements. Further, it may be observed that unless heavily armoured a Red Cross ship coming anywhere within the radius of an action would be sunk, and, till sunk, would afford cover to torpedo craft; and this, if the boats were thereby enabled to sink a ship, would produce a war against the power to which the ship belonged.

THE Russians are said to contemplate a thin armoured skin to their ships' bottoms in future, as a torpedo antidote. We are hardly disposed to credit the report, since, even were an effective defence of this kind evolved, torpedo charges would soon be increased to meet it. Possibly the tale has arisen from some projected use of the movable shields invented some while since, but of which no trials that we know of have yet been made.

In reply to a correspondent whose letter was mislaid, the destroyer whose central funnel "looks like two bound together" is the *Spiteful*. All, or nearly all, three-funnelled destroyers have the centre funnel in duplicate, but the two are usually cased together. Very few destroyers are exactly alike, and those who know them well are tolerably able to distinguish between them.

THE old ships in reserve at Portsmouth are now doing their triennial trials. Such as have been out have done satisfactorily, but the speeds have not exceeded nine knots very much. The *Neptune*, which goes out shortly, has the proud distinction of being almost the only ship in our Navy fitted with a bathroom. Elswick fits splendid baths to 4000-ton ships; but in our biggest vessels every officer has to make shift with his own sponge-bath.

BRITISH ASSOCIATION OF DRAUGHTSMEN, MANCHESTER BRANCH.—The next meeting of the above Association will be held at the Deansgate Hotel on Thursday, November 2nd, at eight o'clock, when a paper on "Water-tube Boilers" will be read by Mr. W. G. Primrose, member. All information can be obtained from the branch hon. sec., Mr. W. E. Butcher, 209, Great Cheetham-street West, Manchester.



Fig. 2—LAYING TWO-WAY "VENTURI" METER IN LONDON

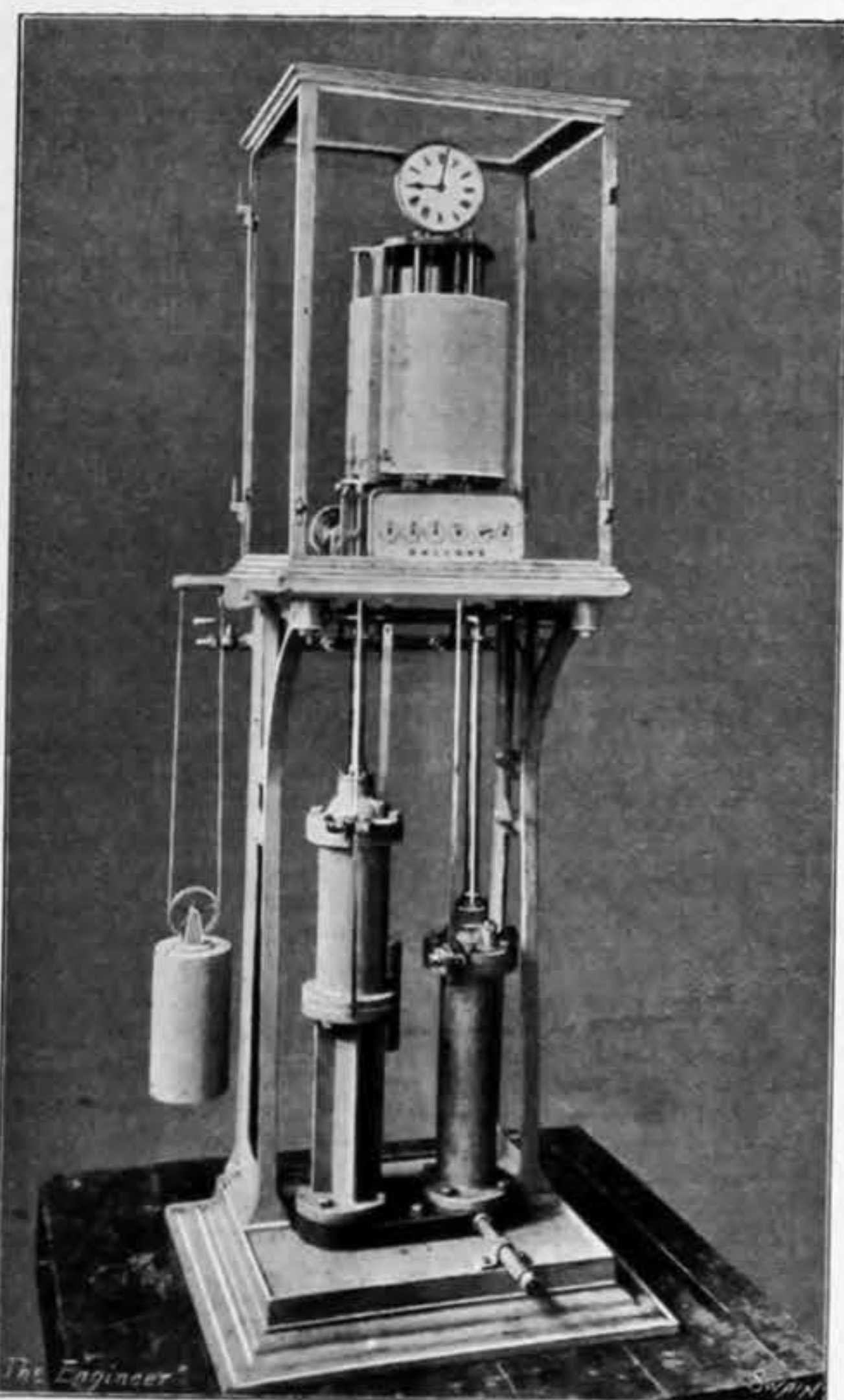


Fig. 1—RECORDING MECHANISM

any deviation in the pipe line, and the loss of "head" owing to the throttling of the pipe is imperceptible. Moreover, the recording point may be some considerable distance from the actual point of measurement, and the pressure pipes may be led to any convenient position.

The deviation from the ordinary course of "one-way" measurement, that is to say, where the water is always flowing in one direction, has recently been necessitated in consequence of the intercommunication of two London water com-

THE SWEDISH IRON AND STEEL, METAL, AND COAL INDUSTRIES IN 1898.

In conformity with our custom in former years, we now present a résumé of the official reports on the Swedish iron and steel, metal, and coal industries in 1898. Last year magnetic iron ore was raised from 329 mines in ten län or counties, the total output being 2,302,546 tons, as against 366 mines and 2,086,119 tons in 1897. The increase in output was thus 216,427 tons, or 16.4 per cent., the output being the largest on record. The following table shows the output of iron ore, the number of mines worked, with increase and decrease during the quinquennial period 1893-98:-

Table with 4 columns: Mines, Output, Increase or decrease, per cent. Rows for years 1893 to 1898.

The chief increase in output last year took place in Norrbotten's län, viz., 239,851 tons, here being situated the great Gällivara mines. On the other hand, Kopparberg's län, the second greatest iron producing county in Sweden, shows a falling off of 45,395 tons, of which 38,000 tons in the well-known Grängesberg mines. The other iron-producing län show an increase in output of 26,493 tons in all, against which there is a decrease of 4522 tons. To this Orebro län contributed 16,000 tons. In the whole country the total quantity of ferrous rock broken out amounted to 3,944,357 tons, which, yielding 2,276,568 tons of ore, shows an average of 57.7 per cent, as against an average of 56.8 per cent. in 1897. In three län the average rose from 36.4 per cent. to 61.1 per cent., but in two others it fell from 62.1 per cent. to 58.7 per cent. In the Gällivara mines the average rose from 49.6 per cent. to 60.1 per cent. Of the total output, 2,046,010 tons, or 89.6 per cent., consisted of magnetic or so-called "black" ore, and 238,556 tons, or 10.4 per cent., of "blood-stone."

The output of the latter kind of ore last year was a little larger than in 1897. The total value of the ore raised last year is estimated at 11,000,000 kr., as against 10,000,000 kr. in 1897—18 kr. = 20s. This gives an average of respectively 4.78 kr. and 4.79 kr. In this industry there were employed last year sixteen magnetic ore separators, which treated 81,500 tons, as against ten separators and 26,000 tons in 1897. The total number of hands employed in the industry last year was 9274, so that the average output for each was 248.3 tons. The following figures show the great progress made in this respect during the last quinquennial period:-

Table with 4 columns: Hands, Average tons. Rows for years 1893 to 1898.

It may be of interest from a technical point of view to mention that last year 3972 hands were employed underground, their average output being 398 tons, as against 3620 hands, 434 tons in 1897. This decrease is due to the circumstance that at Gällivara a larger number of hands are employed in cutting galleries and other work. In the open the average outbreak per man was 1402 tons. In addition to magnetic ore, a small quantity of lake and bog ore was raised last year, viz., 368 tons, valued at 1645 kr., or 4.47 kr. per ton. In 1897 the production was 1047 tons, but it has been as much as 12,000 tons. The "fishing" for this kind of ore is carried on in three central län, and the raising depends greatly on the length of water when the lakes are frozen. Adding the lake and bog ore to the quantity of magnetic ore, the total output of all kinds in Sweden last year amounts to 2,302,914 tons, as against 2,087,166 tons in 1897.

Coming to the pig iron industry, we learn that last year 143 furnaces were in blast, and twenty-eight idle, the total manufacture being 531,766 tons, in 39,847 shifts of twenty-four hours, valued at 34,867,000 kr. Of this quantity 7806 tons were produced direct from the furnaces. In 1897, 144 furnaces returned in 41,168 shifts, 538,197 tons of pig, which shows a falling off of 1.2 per cent. The following table shows the manufacture of pig iron, with increase and decrease during the given quinquennial period 1893-98:-

Table with 4 columns: Tons, Increase or decrease, per cent. Rows for years 1893 to 1898.

There was an advance in manufacture in the counties of Vestmanland, 4590 tons; Ostergötland, 1000 tons; Upsala, 750 tons, &c., but, on the other hand, a falling off in Orebro of 4750 tons; Kopparberg, 4160 tons; Vermland, 1980 tons; Kalmar, 1550 tons; Vestmanland, 1246 tons, &c. The increase in the divers län ranges from 1 to 13 per cent., and the decrease from 3 to 100 per cent. The prominent place which from ancient times has been occupied in the Swedish pig iron industry by the two län Orebro and Kopparberg has also been maintained in 1898, when they returned over one-half of the total production of the country, or 52.4 per cent. Next in order comes Gefleborg's län, with 13.5 per cent. Vermland, 10.6 per cent.; and Vestmanland, 10.4 per cent., seven other län making up the remainder, 13.1 per cent. The average output per furnace last year amounted to 3719 tons, the average time of blasting to 279 shifts, and the average return per shift to 13.35 tons. The following table is of considerable interest, as it shows the progress made from a technical point of view in the manufacture of pig iron in Sweden during the quinquennial period 1893-98.

Table with 4 columns: Average output per furnace, Average output in 24 hours. Rows for years 1893 to 1898.

Of the län Vestmanland shows the largest average manufacture per furnace, viz., 4590 tons, and Ostergötland the highest average period of blasting—365 shifts of 24 hours. The lowest average return, 130 hours, and the lowest shift, 23, are shown by Jynköpings län. The largest average decimal return was in Kopparberg's län, viz., 16.69 tons per furnace, and the lowest in Jynköpings län, 5.61 tons. In the former county is situated the well-known Donnarvet Iron and Steel Works, the largest in Sweden, where the average decimal output was 35.81 tons, the highest of any works.

The manufacture of the various kinds of pig iron is returned as follows:-

Table with 2 columns: Item, Tons. Rows for Forged and puddled, Bessemer and Martin, Spiegeleisen, Ingots for reduction, Ingots for other purposes, Total.

The following table shows the production of these kinds of iron during the last quinquennial period:-

Table with 6 columns: Item, 1894, 1895, 1896, 1897, 1898. Rows for Forged and puddled, Bessemer and Martin, Spiegeleisen, Ingots for reduction, Ingots for other purposes.

The first-named kind, forged and puddled pig, was manufactured in eleven of the twelve iron-producing län, varying from 66,147 tons in Orebro to 985 tons in Södermanland. Bessemer and Martin iron was turned out in ten län, of which Orebro, Kopparberg, and Gefleborg returned three-fourths of the total. Spiegeleisen was only manufactured at the Schisshyttan and the Nykroppa Works. Of the other kinds Orebro produced no less than 77.4 per cent.

Turning to the manufacture of malleable iron and steel, we find that such took place at 126 works, as against 132 works in 1897, which were situated in eighteen län, the largest number, twenty-one, being in Orebro, Kopparberg coming next with sixteen; Vestmanland, fifteen, &c. The number of Lancashire hearths numbered 293 in fourteen län; Franche-Comté hearths, seventeen in nine län; Walloon hearths, twenty-two in three län, whilst there were seventeen for other methods of manufacture. The total of all kinds of hearths in operation thus numbered 349, whilst of puddle furnaces four only were in use as in the preceding year. In the production of ingots in 1898, seventy-eight furnaces were in operation, of which twenty-seven were Bessemer, forty-five Martin, and six crucible, with six blister steel furnaces. The following figures show the manufacture and value, last year, of malleable iron and steel:-

Table with 2 columns: Item, Tons, Kr. Rows for Unwelded blooms and raw bars, Unwelded ingot metal, Bloom and blister steel, Total.

The manufacture of blooms and raw bars was carried on in sixteen län, Orebro showing the largest output, viz., 42,684 tons; the largest portion of manufacture under this head, 184,356 tons, or 92.7 tons, being Lancashire blooms. The production of blooms by the Franche-Comté process amounted to 12,205 tons, or 6.1 per cent., and that of others to 2362 tons, or 1.2 per cent. During the past six years the manufacture of blooms and raw bars by all processes has been as follows:-

Table with 2 columns: Item, Tons. Rows for years 1893 to 1898.

These figures show that whilst during the first four years there was a falling off in the manufacture, in 1897-98 there has been an advance last year of no less than 9291 tons, or 4.9 per cent. Of the other kinds of such iron as are here referred to, 102,254 tons, or 38.7 per cent., was Bessemer; 160,706 tons, or 60.9 per cent., Martin; and 1013 tons, or 0.4 per cent., crucible metal, nearly all being ingots. The manufacture of these kinds of iron during the period 1893-98 has been as follows:-

Table with 4 columns: Bessemer, Martin, Crucible, Totals. Rows for years 1893 to 1898.

If the figures for 1897-98 be compared, it appears that there is a falling off in the make of Bessemer metal of 5425 tons, and of Martin 5130 tons; but as there is an increase in the make of crucible of 322 tons, the total falling off in the manufacture of ingots, in 1898, is 10,233 tons, or 3.7 per cent. As in former years, Bessemer metal was manufactured in five län, as against Martin metal in twelve län. Five län produced three-fourths of the total. By the basic dephosphorisation method there was produced 84,534 tons of ingots, included in the above quantity, viz., 29,194 tons Bessemer, 55,049 tons Martin, and 291 tons Martin cast goods. Nearly one-half of this quantity, or 41,817 tons, was produced at the Donnarvet works, 10,365 tons at Avesta, and 9560 tons at Hofors. That this method of manufacture is gaining steadily in favour in Sweden is shown by the following figures of output:-

Table with 4 columns: Bessemer Ingots, Martin Ingots, Martin Cast goods, Totals. Rows for years 1893 to 1898.

As regards the manufacture of bar iron and steel, with coarser kinds of iron and steel goods, last year in Sweden, we learn that the total output of all kinds amounted to 330,193 tons, valued in round figures at 50,000,000 kr., as against 332,559 tons in 1897 (value not returned). Of the former quantity 47.11 per cent. was made from malleable iron, and 52.80 per cent. from ingot metal. In the manufacture were included 13,500 tons blooms and billets (1897, 13,700 tons); bar iron and steel, 170,374 tons (156,000 tons); fashioned iron, &c., 9500 tons (7840 tons); hoops, nails, &c., 77,400 tons (74,300 tons); rod iron, 23,882 tons (24,300 tons); mains and tubes, 12,000 tons (33,600 tons); heavy plates, 16,500 tons (16,370 tons); rails, 15 tons (116 tons); tires, 2000 tons (1600 tons); axles, 3100 tons (2500 tons); anchors and similar goods, 2000 tons (1900 tons). The following returns show the production of bars with kindred goods in the period 1893-98:-

Table with 2 columns: Item, Tons. Rows for years 1893 to 1898.

Of the bars 38,963 tons were produced by forging and 117,158 tons by rolling. The following table for the period

1893-98 shows the proportion of bars produced by forging and rolling:-

Table with 4 columns: Year, Forged bars (Tons, Per cent.), Rolled bars (Tons, Per cent.). Rows for years 1893 to 1898.

Of the forged bars manufactured last year 32,919 tons, or 84.5 per cent., were forged from blooms, 5715 tons, or 14.7 per cent., from ingot metal, and 329 tons or 0.8 per cent., from blister steel; and of the rolled bars, 67,752 tons, or 57.8 per cent., rolled from hardened iron and steel, 2204 tons, or 1.9 per cent. from puddled iron and steel; and 47,202 tons, or 40.3 per cent., from ingot metal. Forge bar iron is manufactured in sixteen län, Upsala and Orebro heading the list with respectively 9293 and 7445 tons, while rolled bars are produced in twelve län, Vestmanland returning no less than 25,894 tons or nearly one-fourth of the total production.

Of "other metals" returned as produced in Sweden last year we have 126 kilos. gold valued at 311,892 kr. (1897, 113 kilos.), most of the gold coming from the State mine at Falu; silver, 2032 kilos., value 14,400 kr. (2218 kilos.); lead, 15,564 tons, value 342,458 kr. (1897, 14,798 tons); copper, 2348 tons, value 221,000 kr. (1897, 2886 tons).

As regards the Swedish coal industry the report states that 236,000 tons were raised last year from thirteen deposits in Scania, the southernmost province, of which 52.2 per cent. were "best" coal. The output in 1893-98 has advanced as follows:-

Table with 2 columns: Item, Tons. Rows for years 1893 to 1898.

The coal is anthracite, and suitable as fuel on railways and steamers and for domestic purposes, but can never be of any use in the iron industry. There are employed in the Swedish mining industry 1587 motors, 1116 being water and 343 steam, with a total of 64,620-horse power. The number of hands employed in all mines was 13,527, of which 68.56 per cent. were in the iron mines. There were 656 accidents in mines, nineteen being fatal. Licences were issued for the working of 1859 new mines or deposits, 57 per cent. being in respect of iron. The income derived from the Swedish mines in 1898 is estimated at 11,500,000 kr., as against 10,700,000 kr. in 1897, of which former figure 2,600,000 kr. were derived from the iron mines, and 7,500,000 kr. from the iron and steel works. Of these sums Kopparberg's län heads the list with 2,813,000 kr., Orebro coming next with 2,200,000 kr., Vestmanland 1,500,000 kr., &c., the smallest being 500 kr.

AUSTRALIAN NOTES.

(From our own Correspondent.)

IN a retrospect on the mining industry in Queensland the Under-Secretary emphasises the fact that floating mining ventures into companies has in many cases ended in absolute failures, that portion of the subscribed capital that usually is absorbed for the sole benefit of the promoter is, as a rule, out of all proportion to the intrinsic value of the undeveloped property, and cannot reasonably be expected to yield returns in the future. When to this unreasonable handicap the frequently unnecessary and exorbitant directors' fees, and numerous other items of this kind, are added, the success of the great majority of such ventures would be simply marvellous. There are many instances where not one-tenth of the subscribed capital found its way into bona fide mining operations. In the case of almost every one of the prosperous mines the adventure was started either by a small party of men, or a syndicate, when every care was exercised that not a penny of the money that was brought into it by the co-partners was expended beyond the bona fide testing and developing of the mine.

The value of gold raised during the year 1898 was £2,750,349, showing an advance of £112,120 on the preceding year. The total number of men engaged in quartz-mining was 6075. The total number of gold-mining leases in force was 527, with an average area of 13 acres, 2 roods, 33 perches. Charters Towers still maintains its pre-eminence amongst the goldfields of this Colony; 728,569 tons of ore and sand, yielding 457,850 oz. of gold to the value of £1,157,005, was extracted during the year.

The Mount Morgan mine has continued in its even course of prosperity. The output of stone during the year shows an advance on the previous one of nearly 60,000 tons, but the produce is a little over 7000 oz. short. The only alluvial goldfield worth mentioning in the Colony is Peak Downs, with a return of 30,911 oz. for the year. An approximate estimate of the gold production of Australasia for the year 1898 is furnished by the Deputy Master of the Royal Mint, Melbourne, as follows:-

Table with 2 columns: Item, oz. Rows for New South Wales, New Zealand, Queensland, South Australia, Tasmania, Victoria, West Australia.

The quantity and value of minerals raised in Queensland during the year 1898 is shown in the following table:-

Table with 3 columns: Item, Tons, Value. Rows for Copper ore, Silver ore, Antimony ore, Coal, Tin ore, Opal, Manganese, Bismuth, Wolfram, Lead.

The transactions for the year ending June 30th last, on the New South Wales railways, constitute a record, both in gross and net earnings.

During the year the extension from Berrigan to Finley, a distance of 13 miles 73 chains, was opened for traffic, and further extensions of the "Pioneer" class are now under construction, viz., Byrock to Brewarrina 58 miles 11 chains, and Moree to Inverel 60 miles 59 chains.

Gross earnings show an increase of £118,525, made up as follows:-

Table with 3 columns: Item, Increase, Decrease. Rows for First-class passengers, Second-class, Parcels and miscellaneous, General merchandise, Live stock, Coal and coke, Other minerals, Wool.

In connection with the increased earnings 1,492,861 additional passenger journeys were made, and 393,338 tons of additional traffic conveyed.

It has been decided to introduce Sykes' system of lock and block

on the busy suburban sections. The fitting of the Westinghouse quick-acting brake on the whole of the goods stock has now been completed.

Several improvements have been effected for the accommodation of the traffic. Second-class corridor lavatory carriages have been placed on the Sydney-Melbourne express; and Pullman sleeping cars have now been attached on the northern express trains running to Brisbane.

Three hundred and thirty new goods vehicles have been added to the stock, and provision has been made for eight new powerful goods engines to replace twelve of smaller type. Extensive improvements have been made in grades and curves on various parts of the lines during the year.

With regard to the tramways, the electric line Ocean-street, Woolahra, to Rose Bay, a distance of 1 mile 24 chains, was opened on October 4th last.

The completion of the power-house at Ultimo, and the necessary cable connection with North Sydney, will permit of the existing mixed system of electric and cable, now running in the populous northern suburb being made wholly electric.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

A remarkable train performance.—One of the new six-coupled bogie express engines of the New York Central Railroad recently made a run of 143 miles in three hours thirteen minutes, including two stops, giving an average speed of 44½ miles per hour. The highest running speed was about 60 miles per hour. The interesting feature of the run is the great weight of the train, which aggregated 918 tons as follows:—

Table listing engine and tender, mail cars, passenger cars, dining cars, sleeping cars, parlor cars, and other train components with their respective weights in pounds.

The total length of the train was 1202ft. The engine had six-coupled wheels, and its leading dimensions were as follows:—

Table listing dimensions for cylinders, driving wheels, bogie wheels, boiler diameter, boiler pressure, fire-box, tubes, heating surface, grate surface, weight of driving wheels, tender weight, and other mechanical specifications.

Another monster locomotive.—This is the era of heavy locomotives and heavy trains, and the Illinois Central Railroad has recently received an engine weighing 104 English tons, or 163 tons with its tender, which carries 12 tons of coal, and 7000 gallons of water. The engine is of the twelve-wheel type, having eight coupled driving wheels, and a four-wheeled leading bogie. The boiler of this enormous machine is 6ft. 8in. diameter, with a Belpaire fire-box 11ft. long, placed above the frames. The working pressure is 210 lb., and the engine is intended to haul train loads of 2000 tons up gradients of 1 in 130. The leading dimensions are as follows:—

Table listing dimensions for cylinders, driving wheels, bogie wheels, driving wheel base, engine wheel base, engine and tender wheel base, length of engine, length of engine and tender, weight on drivers, weight of engine, journals of driving axles, piston slide valves, travel, length of connecting-rod, boiler diameter, fire-box, size inside, fire-box, depth, tubes, diameter, tubes, length, heating surface, tubes, heating surface, total, grate area, smoke-box, length, funnel, diameter at top, funnel, height, rail to centre of boiler, rail to top of funnel, tender, bogie wheels, weight loaded, length of underframe, length of tank, width of tank, height of tank.

Consolidation of bridge-building interests.—The American Bridge Company is being organized for a consolidation of a majority of the leading bridge-building firms in the United States, with a capital stock of about £13,500,000, of which £5,400,000 will be 7 per cent. preferred stock, and £8,100,000 common stock. The audits show an average of 13 per cent. earning for the individual concerns during the past three years, although that period has included a time of severe depression in the bridge-building industry. One great point to be aimed at is economy of production, the work being done at the shops nearest to the site of the bridge, thus avoiding heavy charges for transportation. In recent instances a contract for a bridge on the east coast was taken by a firm in the west, while at the same time an eastern firm took the contract for a western bridge. The cost for shipment of material was estimated at £9000. This was one of the points which was embodied in the organization of the railway carriage and wagon-building "combine," which now distributes its contracts to the works nearest to the railway for whom the wagons are intended. Very satisfactory arrangements have been made with the Carnegie Steel Company for the supply of material during a term of years. The combination will include the great Pencoyd bridge and ironworks, which include a complete steel-making and rolling mill plant, and one of the largest and best equipped bridge works in the world. Several of the companies have foreign contracts in hand, and the consolidated company will organize a special foreign department, and enter into competition for export work. The work will not be confined to bridges, but in-

clude steel structural work for factories, power stations, &c., which work is made a speciality by several of the companies. The consolidated company will comprise twenty-eight companies, which are said to control nearly 90 per cent. of the metal bridge and structural work of the country. About ten or a dozen companies are still outside, but some of these may decide to join the combination.

THE LATE MR. W. E. METFORD AND THE INDIAN MUTINY.

THE following interesting communication from the Hon. T. F. Fremantle appeared in the Times of Wednesday:—

Mr. Metford—a young railway engineer of thirty-three—had arrived in India with his wife, and set up house about three miles from Monghyr, on the Ganges, in the middle of May, 1857. In the early days of June there was evident risk in remaining any longer isolated in the country; they moved into Monghyr, where the situation was becoming an anxious one. Mrs. Metford's journal runs as follows:—

"June 11.—William making bullets all day. Thirty Sowars marched in, Mr. T.—the magistrate—very cleverly putting them into the unoccupied part of the gao, so that they could combine with the prisoners. June 13.—Eight or ten gentlemen came to discuss affairs. News that some of the same regiment that we have to defend (!) us have just murdered their officers at a neighbouring station. It was decided to send supplies to the fortified house, and the women and children. Patrols decided on. Our party keep a look-out on the gate near us, and others at the four others, and communicate with each other continually, besides a strong guard at Dr. McCreagh's—the fortified house. June 17.—William out continually; he is getting quite the head of the military arrangements here. It is well known that shells and murderous inventions are being made in abundance by 'Metford Sahib,' and there is a pretty strong feeling of respect for this corner of the fort. Mr. T. dare not give any orders; so the Sahibs take it on themselves. William very savage at the proposal by Mr. R. that everyone should take to the boats, and lie off shore ready to fly; I am ashamed to say this Mr. R. has a tolerably large party. June 16.—A report came this morning through the servants that the people in the bazaar said, 'All the Sahibs had run away to the river, and that they were coming to loot their houses.'"

Unluckily part of the journal was lost, and there is a gap here of nearly six weeks. It is resumed on July 26th. "William worried to death with his own and everybody else's business. You would think he was the head of the station to see how everyone comes to him for everything and looks to him for guidance." Then came a departure of some of the Europeans by boat. They were urged to join them. But Mr. Metford felt that if he left his staff would go too, and that there would be many left defenceless to almost certain violence. Mrs. Metford refused to leave her husband. Her journal says:—

"There is only one lady left here besides myself. . . . Kept my boots on in case one might have to make a rush for Mr. Hillyar's boat. He is kindly staying at Monghyr, as he does not like to leave us entirely without refuge in case of a visit from the Sowars. Mr. T. and William intend to make a regular fortification provided thirty men can be made to sign a paper that they will in case of necessity fight and defend themselves and families; thus, instead of flying, this is now being arranged by William, who is still very unwell. . . . The last steamer would not spare us any troops."

Early in August English soldiers arrived at Monghyr, and Mr. and Mrs. Metford went down the river to Bhagalpore, he being now quite broken down by his exertions. His illness was, says Mrs. Metford, "brought on by his hard work, mental and physical, for he kept watch for seven weeks nightly, two hours at a time, sometimes four. . . . and this, together with the work his own energy brought on him in the station; for people soon began to see he was the only one who could and would do anything, and came to him about every trifle. Consequently he suffered severely for it. . . . And the entire arrangement of the night guards was in his hands."

If there was no massacre at Monghyr, surely it was due to the unsensational heroism of one man. But no reward was his; he had to return home in broken health, and to give up his profession. He was never again equal to the stress of continuous work. Yet, taking up again an old hobby, he became a pioneer in developing rifles and ammunition. Ever unselfish, he gave to the world the improvements which he made; and encroached almost unwisely upon his own means to carry out the experiments that he loved. In him England has lost a man to whom she owed a double debt; his friends, one whose able and original mind was made attractive by its wide sympathies, and complete lack of pettiness or self-seeking.

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

(From our own Correspondent.)

ENGINEERING sections of both iron and steel were in great demand on 'Change this—Thursday—afternoon in Birmingham, and from the character of the negotiations which took place it was very clear that producers and sellers were able to ask almost what they liked within reason, without consumers being very much disposed to grumble. The fact is, there is so much work in hand in all departments of the engineering trades, that material must be obtained in order that contracts may be executed, and therefore engineers are not disposed to cavil over a little increase in prices in the present state of decided trade revival.

Bessemer billets and blooms are quoted £6 to £6 5s.; Siemens, £6 5s. to £6 10s.; mild steel bars, £8 10s. to £9; steel plates, £9 to £9 5s.; and steel girders and angles, £8 to £8 10s. The reports as to the steel trade in America are also very encouraging, especially as regards steel for constructive purposes.

The war does not appear to have exerted a depressing effect upon the Midland trade. In fact, an appreciable accession of business was this afternoon reported as the result of the activity in military circles consequent on the Transvaal operations.

The best iron houses announced that they have booked some very good orders for best plates, bars, and rivet iron for the Royal Arsenal. Both the War-office and the Admiralty are, indeed, inquirers for large quantities of finished iron, particularly in plates, bars, and angles, for transport wagons and other military rolling stock, whilst best hoops for the securing of ammunition cases have also been ordered. A considerable order for hoops, estimated at 5000 tons, is said to have just been placed in the district on American account, and it was at first thought that these had reference indirectly to war service, but it is understood that they are destined for use in connection with the American cotton crop for baling purposes.

Manufactured iron is firm and active. Hoops are quoted £10, strip £9, rods £10. For tube strip £9 to £9 2s. 6d. is asked. Puddled bars are changing hands at £6; marked bars remain £10. Several sheet iron makers, recognising the large trade which is being done by the bar iron makers, are desirous of entering the latter industry, and are credited with the intention of altering portions of their works accordingly. Among these are the Monmore-lane Iron Company, Willenhall, which is altering one of its sheet iron mills into bar mills. Sheet singles are quoted £9 5s. to £9 7s. 6d.; doubles, £9 10s. to £9 15s.; and triples, £10 2s. 6d. to £10 5s. Galvanised corrugated sheets, f.o.b. Liverpool, are in good demand on Australia and India account at £13 10s. to £14, but the South African trade is stopped by the war. Good boiler plates are in request at about £11. For rivet iron £9 to £9 10s. is asked.

Pig iron is in good demand, and producers have almost more work on the books than they can get through. Cold blast pig iron is quoted 115s. to 117s. 6d.; hot air, 85s. to 90s.; part-mine 75s. to 77s. 6d.; and cinder, 68s. 6d. Both Staffordshire and Midland brands are in excellent demand, and the furnace owners find a difficulty in supplying consumers with the promptness which the latter desire. Northampton are quoted 75s., and though 72s. 6d. is here and there accepted, the figure is not general. Sellers are chary about accepting any new business, except on the understanding that deliveries, if necessary, be made next quarter. German buyers are reported to be still inquiring for Midland pig iron, the supply in their own country being understood to be a good deal below the demand.

Structural work, both of steel and iron, continues in brisk demand by home and foreign railway companies, and there is a steady stream of orders for electrical appliances and generating machinery for lighting, telegraphic, and locomotive purposes. Engineers and machinists are decidedly busy, and lathes, planing machines, stocks and dies, drilling and lifting appliances, are in specially active request. For gas engines the demand continues very active, and hydraulic appliances of various kinds are in good demand. Mining machinery is still going out in considerable quantities to South Africa, India, and Western Australia, and the new impulse lately given to coal mining in this country by the advance of prices has produced a good crop of orders.

Rapid progress is being made with the extensive buildings at Hadley, near Wellington, for G. F. Milnes and Co., of Birkenhead, for manufacturing electric tramcars and light-railway cars. Some years ago the Nettlefold Company, employing from 600 to 700 men, occupied the Castle Ironworks, and when it moved the works to South Wales the district was practically depopulated. Now houses are being erected for the accommodation of 550 workmen, who will be employed at the new electric car works, which will cost over £100,000. The company will be able to turn out 700 or 800 cars per annum. Already sufficient orders have been booked to keep the men employed for over two years.

Power has been given to the Public Works Committee to construct a bridge across the Great Western Railway at Small Heath to connect Cooksey-road, Small Heath, and Montgomery-street, Sparkbrook. The cost of the work is estimated to be £49,000.

Regret is expressed in Midland engineering circles at the news which has arrived of the death at Sydney, Australia, of Mr. P. B. Elwell, electrical engineer, in connection with colonial railways, and formerly partner in the late firm of Elwell and Parker, of Wolverhampton, who were the first firm of electrical engineers in that town, and whose business was sold to the Electrical Construction Company, of Bushbury. Mr. Elwell—who leaves three sons and two daughters—after leaving Wolverhampton, lived for some time at Deauville, in France, and it was on the death of his wife that he took the appointment at Sydney. Mr. Elwell's former partner, Mr. Thomas Parker, is now managing director of Thomas Parker, Limited, electrical engineers, Wolverhampton.

Mr. Wilfrid L. Spence, A.M.I.C.E., M.I.M.E., of the Electric Construction Company, has been appointed managing director of a new company being formed in Scotland, with the object, *inter alia*, of undertaking the bulk supply of electricity to local authorities. Mr. Spence's head-quarters will be in Glasgow.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—The steady strengthening in the position throughout the engineering and the iron and steel trades of this district to which reference was made last week, is being fully maintained, and there has been a further very general hardening up in prices. Amongst engineers, except that textile machinists are scarcely booking sufficient new work to replace the contracts running out, the reports I receive are for the most part to the effect that there is no perceptible indications of any real slackening off. Perhaps the pressure is not in all cases so great as it was early on in the year, but new work is being given out in ample quantity to take the place of orders on the books as they are completed, and certainly quite another twelve months of exceptional activity is generally regarded as fully assured. Throughout the iron and steel trades makers and manufacturers are, with few exceptions, in the position that they have full order books for the next four or five months, and this is specially the case with regard to most descriptions of finished material. Judging, however, from the fact that here and there merchants continue to quote low figures for delivery next year, there would seem to be still some element of uncertainty as to the near future, but apart from pure and apparently reckless speculation the present outlook of the market scarcely offers the most remote justification for anything like "bear" operations, at any rate over the first half of next year, which is the period covered by some of the low quotations just now being given in the market.

There is still very little buying in what may be termed quantities, but at the Manchester iron market on Tuesday the general report was that a good steady business is being put through, which is not merely the covering of hand-to-mouth requirements, but indicates a growing conviction amongst consumers that at any rate lower prices are not to be looked for just yet, and although they may not care to purchase very far ahead at the present high prices, they are anxious to cover all possible requirements for the immediate future. In fact, consumers, and in many cases merchants, are prepared to place orders in excess of what makers and manufacturers, in the present state of their order books, care to entertain, and a considerable weight of business, particularly when it comes from buyers outside their regular customers, is being declined.

In pig iron there has been a very fair weight of business doing during the past week, and in most cases there has been a stiffening up in prices of from 6d. to 1s. per ton. The list quotations for Lancashire foundry brands remain nominally at 77s. 6d., less 2½, delivered Manchester, but local makers are only able to book very small quantities with new customers, and on these they are asking 6d. to 1s. per ton above their list basis. Much the same remarks apply to Lincolnshire foundry brands, which are in most cases being quoted 1s. 6d. to 2s. per ton over the minimum basis, although one brand of Lincolnshire, it is reported, can still be bought at the basis price. The general quotations are, however, now about 73s. to 73s. 6d., with Derbyshire foundry, which remains practically out of the market, quoted about 77s. 6d. to 78s. 6d. net, delivered Manchester. Forge qualities show an equally strong upward tendency, and, if anything, are more difficult to buy than foundry numbers, the local forges being just now very large users, and even at the advanced rates now quoted consumers are prepared to place much larger orders than makers are disposed to book. Nominally the minimum basis for Lincolnshire forge remains at 70s. 2d. net, delivered Warrington, but 71s. 8d. has been readily got, and in some instances makers are now quoting 72s. 2d. net, with local brands quoted 73s. to 73s. 6d., less 2½. Both Middlesbrough and Scotch brands are about 1s. per ton dearer as compared with last week. Good foundry brands of Middlesbrough, delivered by rail Manchester, are quoted about 77s. 10d. to 78s. 4d. net cash, with Eglington and Gleggarnock, delivered Manchester docks, averaging 79s. to 79s. 6d., and American pig iron about 77s. to 77s. 6d. net cash.

Throughout all sections of the finished iron trade the position is exceedingly strong; this is especially noticeable in bars, makers for the most part having already practically booked their production well over the first three months of next year, and it seems somewhat extraordinary that they should hesitate about officially advancing their list basis to the prices that are just now being got without difficulty in the open market. At a meeting held a few weeks back there was a strong feeling in favour of advancing to £9, but this was limited to £8 15s. At a further meeting held this week it was again urged that £9 should be fixed as the basis price,

but again this official advance had to be held back. In the meantime makers are declining to entertain new business if under £9 per ton, and it is only in exceptional cases that even with old customers they are renewing contracts at £8 17s. 6d. per ton, delivered Manchester district, although the official basis remains nominally at £8 15s. North Staffordshire bars remain at £9 per ton as the basis for delivery here, but in most cases makers would decline to sell forward or to book new business at this figure. Sheets and hoops remain strong at recent full quotations with a very fair business doing. Nut and bolt makers are also busy at full prices.

An active demand continues to be reported generally throughout the steel trade, and except in hematites, which are not more than maintaining late rates—makers, in fact, finding it difficult to get the full prices they have recently been quoting—the tendency is steadily upwards. Some makers of steel billets are now quoting £16 12s. 6d. to £16 15s., and quite indifferent about selling; steel bars range from £8 15s. to £9, and boiler plates are quoted £9 10s. to £9 12s. 6d. delivered here.

For all descriptions of manufactured metal goods there is a continued brisk demand, especially in connection with engineers' requirements, and for locomotive and boiler fittings, but the list rates, although exceedingly strong, remain without quotable change.

In connection with wood-working machinery, I came across, at an exhibition in Manchester, an ingeniously-designed tool that is being introduced by Messrs. Crowley and Duxbury, of Middleton. This machine has been specially designed for trenching, circular moulding, and slot mortising, but is equally serviceable for all kinds of straight moulding usually done on an ordinary wall or other spindle. One feature of the machine is a circular table, on which the work is clamped in such a manner that there is no necessity for the operator placing his hands near the cutter, and thus risk of accident is minimised; it can be given a sliding motion when doing straight work, and a circular motion for circular operations. Special stop devices are introduced to control the motion of this table when doing circular, straight, or taper work respectively, and a stop arrangement is provided to regulate the cut, so that in repetition work a uniform depth of mould is secured. Pulleys of different speeds, and a specially-designed reversing gear to prevent cutting against the grain are also noticeable features in this modern type of wood-working machine.

Except that for house-fire qualities the demand has slackened off, and here and there the output is just now in excess of requirements, the position generally throughout the coal trade remains practically unchanged. All descriptions of fuel for iron-making, steam, and engine purposes continue in pressing request, with many collieries short of supplies to meet the wants of their customers, and prices steadily hardening, but remaining for the present without further official advance.

A steadily increasing demand for shipment is reported, and with supplies not offering at all freely at the ports, owing to the general pressure of the inland demand, prices are tending upwards, ordinary steam coals delivered at the ports on the Mersey not now being quoted under 10s. 6d. to 11s. per ton, and the latter figure representing more nearly the average price.

For all descriptions of coke an exceptionally active demand continues to be reported which is in excess of the production. There is still no official advance in prices, but these are unquestionably hardening where new business comes forward. At the ovens, foundry cokes are very firm at 26s. to 27s. as the minimum, and 20s. to 22s. is being got for furnace cokes.

Barrow.—The demand for hematite pig iron is very fully maintained, and the market is decidedly firm, as very little iron is on sale for early delivery. Makers are very fully sold forward, and have put an extra furnace in blast during the week, making forty-seven furnaces in blast, as compared with forty in the corresponding week of last year. Makers have increased their prices, and are quoting 77s. to 80s. per ton for mixed Bessemer numbers, net f.o.b., and some makers will not sell except at the higher figure. Warrant iron is in good demand at 76s. net cash sellers, 75s. 11d. buyers. Prospects are that higher prices will soon be asked for warrant iron, as supplies of iron, in addition to the make of the furnaces, can only be obtained from warrant stores, makers having at present no stocks of iron to dispose of. During the week warrant stocks have been reduced by 2127 tons, and now stand at 228,924 tons, or 52,945 tons increase since the beginning of the year.

Iron ore is in fuller demand and in fuller supply. Raisers are selling larger parcels of ordinary good sorts, which are quoted at 14s. 6d. per ton net at mines. Best descriptions are quoted at 18s. per ton, and orders are difficult to place for ordinary sorts. The trade in Spanish iron ore is very full, and imports are considerable both at Furness and West Cumberland ports. Prices are steady at 18s. per ton delivered.

The steel trade is very actively employed, and makers are very fully sold forward, while the demand seems to be increasing on every hand. Heavy steel rails are in good request at £6 15s. per ton firm, the demand having strengthened on home, colonial, and Indian account during the past few days. Light rails are in good demand, and tram sections are in full inquiry. Shipping material is in active request, and orders are of fuller volume than of late. Business is very largely held. Hoops, tin bars, billets, armoured hoops, merchant steel, and general heavy forgings are in very full demand, and prices are steady and firm. Prospects in the steel trade have improved considerably of late.

Coal and coke are in very full demand, and business is improving; indeed, orders are so full that collieries cannot fulfil the demand. Prices are distinctly firm and high.

Shipping is much more actively employed than of late. The exports of pig iron last week were 15,683 tons, and of steel, 14,226 tons, showing an increase of 5035 tons of pig iron and 9119 tons of steel. The total shipments this year up to date have reached 414,043 tons of pig iron, and 405,647 tons of steel, showing a decrease since the beginning of the year of 19,679 tons of pig iron, and 37,678 tons of steel.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE pits in the South Yorkshire colliery district are working remarkably well, full six days being given in many cases, although in some instances as much coal is brought to bank in five days as in six. In fact, the coalowners continue to complain that the men are simply using their higher wages in order to give themselves more holidays. The miners' officials meet this complaint by saying that those who "play" in bad times are those who "play" now, but this argument can scarcely cover the whole of the complaints which are made in the various colliery districts. There is a very strong impression abroad that the additional 5 per cent. asked for by the miners' officials will be conceded. It is rather a heavy call, following so close upon the 2½ per cent. and considering the advanced prices of all kinds of colliery stores, but the public view is that the coalowners will not be disposed to risk any stoppage even for the sake of 5 per cent. being put upon the top of 2½ per cent., provided they can get an extension of the Rosebery arrangement following the coal war of 1893. House coal is now in a very brisk demand, the advanced prices recently imposed being readily paid, and large orders placed both in London and the provinces.

Stocks in merchants' hands are by no means large, and these are certain to be inadequate as November approaches, when a further advance may be looked for. Silikstones, in the best qualities, make 11s. to 11s. 6d. per ton; ordinary, from 10s. per ton; Barnsley house, 10s. to 11s. per ton; seconds, from 9s. 6d. per ton. Steam coal is not quite so largely called for, the export season now falling off. For the inland trade the demand continues good, and a fair tonnage is being sent to Hull and other ports. Values con-

tinue firm, Barnsley hards making 9s. 6d. to 10s. 6d. per ton; seconds, from 9s. per ton. Gas coal is being largely delivered on contract account. Engine fuel is as brisk as ever, more particularly in the manufacturing centres of Yorkshire and Lancashire. Engine nuts are 8s. to 8s. 6d. per ton; screened slack, from 6s. 6d. per ton; pit slack, from 4s. 6d. per ton, purchasers who require immediate deliveries having to give a little more. Blast furnace coke has kept steady at the high prices recently ruling, 17s. to 20s. per ton. A meeting of those connected with coke for steel smelting was held at Sheffield on Tuesday, when a further advance was decided upon to the extent of 2s. 6d. per ton, bringing the price up to 25s. per ton, at depôts or coke ovens.

In iron and steel the tendency is still upward, and with the rising values of other materials required in the manufacture of steel, quotations have again been advanced. The inland price now asked for Bessemer billets, of guaranteed temper suitable for the Sheffield trades, is £7 15s. per ton; for mild Siemens steel, £8 10s. per ton, these quotations marking an advance in each case of 10s. per ton for large quantities, and for smaller supplies an advance of 15s. per ton is insisted upon. Makers say that quotations must go up still higher, as the cost of production keeps steadily increasing. Pig iron is in very active demand, the supply being inadequate to what the market requires. As the output in America is unequal to the needs of the American manufacturers, there is some fear that supplies may be sought on this side even to a greater extent than at present. If that is the case, the prices are certain to spring up considerably. At present, hematites may be quoted at from 88s. to 90s., West Coast being very little above the rates quoted for East Coast. Common forge iron is at 67s. 6d. per ton, delivered in Sheffield.

At the East-end establishments, in military, marine, and railway material, the machinery is being run to its utmost capacity. Reference has already been made to the enterprising extensions in course of progress in the armour-plate mills and adjoining shops. These may now be said to be completed, with the result that the Sheffield manufacturers are able to increase their output. Sir William White and several of the Admiralty officials have recently been over the works, and they had an opportunity of seeing how satisfactorily local firms have met the needs of the Department. Deliveries are being pressed for, and further orders for armour are quietly placed from time to time. It is quite evident that the military plant now so remarkably extended will be fully employed for a long time. All kinds of heavy forgings, particularly those required for battleships and cruisers, as well as for large mercantile steamers, are being more freely ordered than ever, several firms having a good year's work in hand. Although the home railway companies are stated to be ordering less freely than last year, owing to the higher prices now required, there is still sufficient work in hand to keep all the departments active, the foreign contracts being exceptionally heavy. Wagon builders have rarely had a better time.

The sudden death is reported from Vienna of Mr. Albert Bohler, the head of the firm of Bohler Bros. and Co., Styrian Steel Works, Sheffield. Mr. Bohler was a prominent member of the Austrian iron and steel industries, and a well-known figure in Vienna society.

NORTH OF ENGLAND.

(From our own Correspondent.)

SINCE last report an active business has been done in all branches of the iron and steel industries, and buyers are still so pressing that much more could be transacted if producers were in a position to accept—or rather to execute—the orders. The fact is that consumers have been holding back, but find that the probability of lower prices during the winter season is not good, they are strongly endeavouring to place orders without further delay, and during the last few days there has been quite a plethora. More especially has this been noticeable in Cleveland pig iron, the makers of which have received many inquiries for iron to be delivered over the first half of next year, and in some cases over the whole of 1900, some of the lots being for 20,000 to 30,000 tons, chiefly on continental account, and buyers are willing to pay within 1s. of the present prompt price. It is not usual to buy at this season for spring delivery, much less for the whole year, but evidently consumers have come to the conclusion that they will probably do worse for themselves if they wait longer, seeing that the general opinion is that a higher range of prices will rule next year than has been reported during the present year. Makers are not at all in a hurry to sell for delivery much ahead, for in the first place they think they can do better by waiting, and in the next they are uncertain as to what the cost of production may be, especially after the end of the first quarter of next year, for prices of labour and of all kinds of materials are rapidly advancing.

The warrant market has been very unsettled this week, consequent on the war news; but this has not affected the general market, the makers being well enough sold ahead to be independent for a time of the changes in the values of warrants. Still, a higher figure has been offered for Middlesbrough warrants than has been reported since the end of July, 70s. 3½d. cash being the rate on Monday; but on Tuesday the price dropped back to 68s. 10½d., not because of any change in the condition or prospects of trade, but because of political intelligence, which was not confirmed on Wednesday, and prices recovered from the relapse. The leading makers have been quoting 70s. per ton for early f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron; but 69s. 9d. has been the more general figure, and this has been paid. No. 4 Cleveland foundry pig iron has all the week been quoted at 68s.; but it was not paid till Wednesday, when some fair contracts were placed at it. Grey forge was quoted at 66s. 6d., and mottled at 66s.; but only small quantities could be offered, for very little is made. Naturally when producers can get such good prices for No. 3, they make as little of the lower qualities as they possibly can, and the manager whose furnaces are producing an undue proportion of them has a "bad quarter of an hour" with his principals. It costs practically the same to produce the lower qualities as to make No. 3, but No. 4 foundry now realises 1s. 9d. less, and grey forge 3s. 3d. less.

Hematite pig iron in this district is very scarce, and has been substantially advanced this week. Last week 76s. would be taken for mixed numbers, but this week 80s. has been paid, and 78s. has been given for delivery over the whole of next year. The fact is, the supply is considerably short of the demand, and producers can dictate their own terms, as there are no warrants to compete with them. It is true there are 12,953 tons in Connal's stores, but the holders thereof are not prepared to sell at present, seeing that the chances of their realising more are excellent. Since the 12th inst. not a ton of hematite pig iron has been taken out of Connal's stores, and only 1200 tons during the whole month. East Coast hematite pig iron is now dearer than West Coast, and the latter is being sent more fully to Sheffield, while less Middlesbrough hematite is going, but there is such a heavy local consumption that this matter does not trouble the makers of the latter. Strong efforts are being made by the iron ore merchants to profit more fully by the good times. They have not done very well of late because freights have gone against them, as also have prices on the other side, so that a good many of their contracts with consumers have had to be completed at a loss. Trade promises so well for 1900 that they cannot see why higher prices should not be paid for ore. Some of them, therefore, have put up their quotation for Rubio delivered at the wharves in this district to 20s. per ton, but as yet buyers have not seen their way to pay more than 18s. 6d.

Exports of pig iron from the Cleveland district this month are satisfactory, for they exceed those of any previous October, except that of 1897. There is naturally a large decline in the deliveries to Scotland, because Cleveland iron now would be dearer to the

Scotch founder than Scotch iron. This month's shipments from this district to Scotland are the smallest that have been recorded in any month for several years. Last month's deliveries were poor, but this month's are 20 per cent. less. As, however, the exports to the Continent are very much better—in fact, they are nearly double the quantity sent in October last year—the total shipments are considerably better than those of the corresponding month last year, and a better price can be got for what is sent to the Continent than if it were despatched to Scotland. The quantity exported this month has been 93,391 tons, as compared with 90,803 tons last month, and 65,605 tons in October, 1898, to 25th. The stock of Cleveland pig iron in Connal's stores continues to decrease, the quantity held on 25th being 84,808 tons, a reduction for the month of 9322 tons.

The manufactured iron and steel industries were never in a more active condition than they are at present, and if the power of production could be considerably enlarged, it would not be difficult to keep the works fully going. Just now the demand is described as too good, for manufacturers are a long way from satisfying it. Advance in prices do not seem in the least to check buying, and where it is a necessity that delivery should be early 2s. 6d. to 5s. per ton more than the regular market prices are given; indeed, in some cases even 10s. more has been paid. Plates and angles have been advanced in value this week, the former by 5s. per ton, and the latter by 2s. 6d., after a similar rise last week. Thus steel ship plates are at £7 17s. 6d.; steel boiler plates at £9 2s. 6d.; iron ship plates at £7 15s.; iron and steel ship angles at £7 12s. 6d. per ton, less 2½ per cent. f.o.t. where delivery is not early. Common iron bars are at £8, and best bars £8 10s., less 2½ per cent., but 2s. 6d. above these figures is frequently paid where delivery this year is needed. Packing iron cannot be had under £7 5s. A marked improvement in business is reported by rail makers, the recent lull in demand having given place to considerable briskness, and good orders have been booked on home as well as export account. Consumers who have been holding off in the hope of easier prices have now come to the conclusion that prices are not likely to decline, but are tending the other way. This being so, they are strong buyers. For heavy steel rails, £6 15s. net at works is the regular figure. Light iron rails are quoted at £7 15s., and £8 has been paid. Steel railway sleepers are about £7 15s. at works.

The death took place on Sunday, at the age of forty-nine years, of Mr. Francis Sanderson, of Stockton, a gentleman well known for many years in the iron and steel industries of the North of England as the secretary of the Moor Steel and Iron Company, which position he held for over twenty years. He commenced his business career with Messrs. William Whitwell and Co., Thornaby Ironworks, Thornaby-on-Tees; afterwards he was connected with the Erimus Iron Company, Thornaby; then with Messrs. Thomas Vaughan and Co., at Middlesbrough. He was appointed to the secretaryship of the Moor Company in 1879, and when this year this concern was amalgamated with the Stockton Malleable Iron Company and the West Hartlepool Steel and Iron Company, as the South Durham Steel and Iron Company, Limited, he was appointed joint secretary, with Mr. Sladden as his colleague. The death is also announced at Darlington of Mr. James Cudworth at the age of eighty years. He was a native of Darlington, and was at one time on the engineering staff of the Great North of England Railway—afterwards the North-Eastern; afterwards and for many years he was locomotive superintendent of the South-Eastern Railway.

The coal trade has shown a good deal of improvement this week in all branches, and now is considerably brisker than is usual even at this period of the year, the large orders given out on behalf of the Admiralty in this and other districts having contributed a good deal towards this. On continental account buying has also been strong, large contracts being given out for next year's execution. The requirements abroad are expected to be even more in excess of the native supply than they have been this year, and prospects for 1900 are accounted exceedingly good. All prices are higher than last week, best steam being raised to 11s. 6d. per ton f.o.b.; indeed, most coals—gas, coking, and bunkering—are quoted at that figure, which shows substantial advances for each this month. Both gas and coking coals are in brisk demand for the Continent. For blast furnace coke 21s. 9d. per ton has to be paid, delivered at the furnaces, and for foundry coke, 23s. to 25s. per ton f.o.b.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron market opened pretty strongly this week, and for a couple of days there was a fair demand for warrants. The success of our arms in South Africa affected the market favourably, in sympathy with the improved condition of the stock markets. There has since, however, been rather a slackening in the market, and the best prices have not been maintained. Business has been done in Scotch warrants between 71s. 4d. and 70s. 6d. cash, and 71s. 9d. and 71s. one month. There has been a comparatively small business in ordinary Cleveland iron, which has sold from 70s. 2d. to 69s. cash, and 70s. 9d. to 69s. 8d. one month. Transactions have taken place in Cumberland hematite warrants from 76s. 8½d. to 75s. 11d. cash, 76s. for delivery in sixteen days, and from 77s. 1d. to 76s. 4d. one month. There has been rather more speculative buying in the warrant market, which is understood to have been influenced quite as much by the good shipments as by the causes indicated above.

Prices of Scotch makers' iron are as follows:—Govan, f.o.b. at Glasgow, No. 1, 71s. 6d.; No. 3, 71s.; Carnbroe and Wishaw, Nos. 1, 76s.; Nos. 3, 72s.; Clyde, No. 1, 81s.; No. 3, 76s.; Calder, No. 1, 81s. 6d.; No. 3, 77s.; Gartshorrie, No. 1, 82s. 6d.; No. 3, 77s. 6d.; Summerlee, No. 1, 83s.; No. 3, 78s.; Coltness, No. 1, 88s.; No. 3, 80s.; Glangarnock at Ardrossan, No. 1, 81s.; No. 3, 74s.; Eglinton at Ardrossan or Troon and Dalmellington at Ayr, Nos. 1, 77s. 6d.; Nos. 3, 75s.; Shotts at Leith, No. 1, 83s. 6d.; No. 3, 78s.; Carron at Grangemouth, No. 1, 82s.; No. 3, 77s. per ton.

Since last report an additional furnace has been put in blast in Scotland, and there are now 83 in operation, compared with 82 at this time last year. Of the total 40 are producing ordinary pig iron, 39 hematite, and four basic iron.

The heavy consumption of pig iron at home, together with the increased shipments, have continued to tell on the stocks, and the stock in the Glasgow warrant stores has been reduced in the course of the past six days by 2789 tons, and now amounts in the aggregate to 282,080 tons, showing a reduction since the beginning of the year of 34,427 tons.

There is a good and steady demand for Scotch hematite pigs, which are quoted by merchants 82s. 6d. per ton for delivery in railway trucks at the steel works.

The shipments of pig iron from Scottish ports in the past week have been 5487 tons, compared with 3241 in the corresponding week of last year.

The finished iron and steel trades show scarcely any feature of novelty. At all the works there is good employment, and most of them are very busy. With reference to fresh orders, it is understood that in the last week or two some difficulty has been experienced in arranging new contracts for steel. An impression seemed to be taking possession of the minds of those having such work to give out, that they should now be able to place their orders on somewhat easier terms than those recently prevailing. No doubt there has been some disarrangement of business, and the state of affairs at the Cape has not told favourably on the manufacturing branches of the trade, but makers are not in a position just now to make any material concessions as to prices. The reason of this is that they have to pay full rates for the raw material; indeed, while there has been some irregularity in the warrant market, the makers of hematite pigs have lately

raised their prices 6d. to 1s. per ton. It is therefore impossible for the steel makers to cheapen their products at the moment. Several good contracts are reported to have been placed with Clyde shipbuilders and engineers, and probably these may help to strengthen the tone of the steel trade. The finished iron branch is well employed.

The ironfounding and engineering trades are well supplied with work. Engineers and boiler-makers are very busy. The locomotive works have been doing well, and marine engineers have their books well filled. There is great activity in the ironmongery branches of the foundry trades, both in the Glasgow and Falkirk districts; but competition is becoming very keen, and with the, at least, temporary loss of the South African trade, makers are not without some anxiety as to the future.

The coal trade continues active; and indeed the tone this week has, if anything, been rather firmer. It is true that the warrant shipments are not quite up to the mark. The aggregate clearances from Scottish ports in the past week were 178,760 tons, compared with 194,817 tons in the preceding week, and 166,986 tons in the corresponding week of last year; but this falling off is considered only temporary, due to a scarcity of handy tonnage, and the demand for export is very encouraging. The Government has been taking up large quantities of Welsh and other coals, and the coalmasters in this district have been profiting by this fact both directly and indirectly. It is reported that the best ell coal has been sold in the Glasgow market at 10s. 6d. per ton f.o.b. for delivery over the whole of next year. The demand for shipment to the Continent is coming away very well. Main coal is quoted f.o.b. at Glasgow, 9s.; steam, 10s. to 10s. 3d.; ell, 10s. to 10s. 6d.; splint, 10s. 3d. to 10s. 6d. per ton. Business has been done in Glasgow market from 18s. 3d. to 18s. 9d. cost, freight, and insurance for shipment of coal to Genoa next year. These prices are about 1s. per ton higher than those of the current year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

MR. D. A. THOMAS has unquestionably a thorough knowledge of the Welsh coal trade and a keen insight into the possibilities, and upon this at all events his opinions carry force. He is quoted this week as predicting to a friend a burst of prosperity in the Welsh coal trade of the future. "It has not," he states, "been so healthy for many years," and he expects that by next year there will be an advance in wages to the extent of 40 to 50 per cent.

Speaking to one of the principal colliery managers, this gentleman regarded the trade as sound and good, and labour questions were not so troublesome, but, he added, "the great difficulty is getting the men to work regularly. They find that by working four or five days a week they earn enough money for ordinary needs, and they stay away a day or two. It is a common occurrence for forty or fifty men to be absent from a certain pit. Hence the loss to colliery owner, lessened output, buyers cannot get so much coal as they need, and vessels leave the port in ballast."

The grave question now in front is the settlement, or not, with the engineers, fitters, &c. There is a disposition to arrange peacefully, but one point is a difficult one to settle—the hours of work. Men demand eight hours daily, which would be equivalent to a 50 per cent. advance. In some cases, as in the management of winding engines, there is admittedly skill and care required; but there are some sections of the employes whose duties are light, such as lads of sixteen, with a little training, could accomplish.

In addition to a large general demand for steam coal, which has also sold well on dry coals, the war is giving an impulse. It is stated that twenty steamers, with a carrying capacity of 50,000 tons, have been chartered by Government at Cardiff. Coal tramps laden for Cape Town are leaving daily, and the increased naval movements may be expected to lead to increased demands. It was reported this week on 'Change, Cardiff, that shipments were unexceptionally heavy, and that best and second steam were scarce; that the output at the chief collieries was barely sufficient to cover the increased requirements of the Admiralty and deliveries on contract account. Swansea coal trade is brisk, and the last week's shipments were 7000 tons in excess of the corresponding week. Newport also is coming up to its old figures. Last week it despatched close upon 80,000 tons foreign and coastwise.

This week it was stated in Cardiff that the Orient line requirements will be obtained from Cardiff. These will amount to 40,000 tons steam. The contract was secured by Dinham, Francis, and Co., London Coal Exchange. Coal specified, Lewis, Merthyr.

Mid-week the coal market at Cardiff was in an excited state, and some fancy prices, as much as 15s. 6d., were realised for best steam in order to complete urgent cargoes. There was a strong demand also for dry coals, and for Monmouthshire. House coals were reported as getting into the winter rut, and gas coals advancing. Small steams are decidedly looking up, and it was stated on 'Change that inquiries for next year were numerous, and that business had been done at 7s. 3d. to 8s. 7d. per ton, according to quality.

Closing prices, it will be seen, show a distinct advance all round. Cardiff quotations:—Best steam, 14s. 6d. to 15s.; seconds, 13s. 3d. to 14s. 3d.; drys, 13s. to 13s. 9d.; best Monmouthshire for Cardiff shipment, 13s. to 13s. 3d.; seconds, 12s. to 12s. 3d.; best steam smalls, 8s. 9d. to 9s.; best seconds, 7s. 9d. to 8s. 3d.; inferior sorts, 7s. to 7s. 6d.; best house, 14s. to 14s. 6d.; No. 3 Rhondda, 13s. 6d. to 13s. 9d.; brush, 11s. 9d. to 12s.; small, 10s. 6d. to 10s. 9d.; No. 2 Rhondda, 11s. 9d. to 12s.; through, 9s. 6d. to 10s.; small, 8s. to 8s. 9d. No. 2 Rhondda is noticeable for its marked advance.

Swansea prices:—Anthracite, 14s. 6d. to 15s.; seconds, 12s. 6d. to 13s. 6d.; ordinary large, 11s. to 11s. 6d.; small rubble culm, 5s. 6d. to 5s. 9d.; steam, 12s. 6d. to 13s. 6d.; seconds, 11s. 6d. to 12s.; bunkers, 10s. to 10s. 6d.; small, 8s. 6d. to 9s.; house, No. 3 Rhondda, 13s. to 13s. 6d.; No. 2 Rhondda, 11s. 6d. to 12s. 3d.; through, 10s. to 10s. 6d.; small, 8s. 6d. to 9s., all delivered Swansea f.o.b., cash 30 days less 2½.

Patent fuel is expected to move up. The demand is good at all ports. Swansea prices, 12s. 6d. to 13s.; Cardiff, 13s. 3d. to 14s. There is no falling off in coke, and the collection of coke trucks at leading ironworks is an interesting one as showing the variety of sources from whence supplies are obtained, and the number of increased makers. Cardiff prices this week are 24s. to 25s.; furnace foundry, 27s. to 30s.; and special, 32s., a distinct advance for best brands. Swansea figures:—Furnace, 23s. to 24s.; foundry, 25s. to 27s. 6d.; pitwood, 19s. to 19s. 6d., into truck Swansea. Cardiff prices, 17s. 6d. to 17s. 9d.

Notwithstanding that the leading steel works hold large stocks of ore, there has been no falling off in consignments. Ebbw Vale has been particularly brisk, in one day receiving 4000 tons from Bilbao. Cyfarthfa from Decido, and Dowlais from Bilbao, are importing well. A return journey from Newport last week was composed of 500 tons steel rails. Ore from Santander and Marbella has also come in, Swansea receiving nearly 6000 tons. Pig iron imports have also been large from Millom, Workington, Ulverstone, Harrington, and other destinations, Newport receiving over 900 tons, and Swansea 867 tons.

The war has told on the producing department of several works, men not having been too plentiful before, and now large numbers have obeyed the notice to the reserves. Dowlais, I hear, feels the war in this way, and also in another. A large order for rails to Rhodessa is being worked off, but delivery cannot at present be completed, and so the work is suspended for other orders.

The rush of business in all departments of the iron and steel trades is very noticeable; but I am afraid that water supplies are troubling again. At Llanelly several works have been hampered, and I note on the hills extreme economy is being used. There is a little lull in the make of steel rails foreign, on account of the

war; and increased attention is being given for the time to tin and merchant bar, billets, &c. Makers in many parts fail to keep up a sufficient output of steel bar. In the Swansea Valley last week the make of steel was temporarily lessened, two furnaces being out for repairs at Wright and Butler's, Landore. Mannesmann works are in full drive, blast furnaces and coke banks doing well, and all foundries busy. In the Neath district there is a labour movement amongst moulders, which seems to be spreading, Port Talbot men threatening to put in notices. They demand an advance to 32s. Patternmakers are also restive, and are putting in claims for 37s. 6d. The strike continues. Another illustration of the folly of strikes has been given by the hauliers at Llanglwech, who have just resumed work on old conditions after seven weeks' strike. In the tin-plate trade most works are well placed, and there is unabated vigour. In this industry the war is also telling; the supply of tin-plates for canning to South Africa is certain to be abnormally large. The tone of the trade is good. The cold roll difficulty has been arrested, and the boys and wheelers will get 10 to 20 per cent. advance. The Conciliation Board may be expected to meet any difficulty, the owners' representatives having had plenary power given to deal with any question up to January next. Shipments of tin-plates last week were 43,777 boxes; received from works, 55,479 boxes; present stock, 209,826 boxes. Vessels are loading for New York, Russia, and Mediterranean ports.

It was reported on 'Change, Swansea, mid-week, that an unusually large business had been transacted in pig iron, both for shipment and inland. Prices are going up steadily in consequence. Scotch shows an advance of 1s., Middlesbrough 7d., and hematite 1s. 6d. Latest quotations are as follows:—Glasgow warrants, 70s. 10½d., 70s. 9d., 71s. to 70s. 11d., cash buyers; Middlesbrough, No. 3, 69s. 5½d., other numbers in proportion; hematite warrants, 76s. 4d., 76s. 1½d., to 76s. 4½d. for mixed numbers. Cumberland according to brand. Welsh hematite, 1, 2, 3, 82s. 6d.; Welsh bars, £8 15s. to £9; angles at usual extras f.o.t.; sheet, iron and steel, £9 15s. to £10s.; steel rail, heavy, £6 10s. to £6 15s.; light, £7 10s. to £8; sleepers, &c., according to section and specification. Bessemer steel tin-plate bars, £6 5s.; Siemens best, £6 7s. 5d. Tin-plates: Bessemer steel cokes, 15s. 6d. to 15s. 9d.; Siemens, 15s. 9d. to 16s.; ternes per double box, 28 by 20 C., 28s., 29s. to 32s. 6d.; best charcoal, 15s. 6d., 16s. 6d. to 17s. 6d. Big sheets for galvanising, 6ft. by 3ft. by 30 g. per ton f.o.t., £12 10s. to £13s. 10s.; finished black plate £12 to £12 10s.; Canadas, £10 to £10 2s. 6d.; block tin, £141; spelter, £22; copper, Chilli bars, £73s. 15s. to £74; lead, £16 10s.; silver, 26½d. per ounce.

Iron ores, Tafna, 16s. 6d.; Rubio, 17s. 6d. ex-ship. Cardiff slightly different: Tafna, 15s. 9d. to 16s.; Rubio, 16s. 9d. to 17s.

The various spelter works in the Swansea, Morriston, and Llansamlet districts, are in full employment.

A large shipment of bar copper has taken place to Baltimore. The war has brought to light the fact that Welsh tin-plates from the Swansea and Llanelly districts are stationed at Durban and Kimberley, so that America has not been the only country to benefit from the training of Welsh workmen.

Briton Ferry is not going to remain in the rear with all the port improvement going on along the Welsh coast. The dock and basin having been well dredged, a coal tip on the most recent lines is being erected. This will be something towards meeting the increasing tonnage that comes to the port. In this district also the moulders are restive. The output of hematite continues very satisfactory, and the demand is good. The make of tin bar at the Albion and Briton Ferry works is quite up to the average, and all the tin-plate works are turning out well.

At Port Talbot a strike is imminent amongst the railway men. On Sunday last there was a large meeting held, and direct encouragement given by some of the speakers to forcible antagonism. The general secretary of their Union was empowered to say "that all members, irrespective of length of membership, would receive full benefits, which in some instances would be more than the wages some of them were receiving."

After this it will not surprise any one to learn that at the conclusion it was unanimously resolved "that the general secretary be instructed to tender the men's notices at once, and that an appeal be made for the moral support of the Miners' Federation, Dockers' Union, and other labour organisations."

NOTES FROM GERMANY.

(From our own Correspondent.)

THERE is much firmness shown in all the iron trades, but though activity is fully maintained, and will remain brisk throughout the remainder of the year, owing to heavy orders that have been booked for immediate and forward delivery, yet the tone in some departments has been just a little less animated, and the number of contracts received has not been quite so large this week as last. From Rheinland-Westphalia and from Silesia most satisfactory accounts are coming in concerning employment at the blast furnace works; demand for all sorts of crude iron is lively. In Silesia forge pig is now realising M. 75 to 75.50 per cent., and foundry pig stands on M. 85 p.t.; both consumers and dealers are purchasing freely at these rates.

The total production of pig iron in Germany, including Luxemburg, is statistically stated to have been for September of present year 661,068 t., of which 128,042 t. were forge pig and spiegeleisen, 38,830 t. Bessemer, 369,063 t. basic, and 125,133 t. foundry pig.

Production in August of present year was 681,651 t.; in September, 1898, 614,417 t. were produced, and during the period from January 1st to September 30th, 1899, output of pig iron amounted to 6,028,577 t., against 5,450,595 t. for the corresponding period in the year before.

Malleable iron and the various articles of finished iron could not possibly be in better request than they are at present, but there is nothing new or of special importance to be told in connection with these branches of the iron trade. The business done on foreign account is but moderately active. From Silesia a fair export is beginning to be done to Denmark, and a better trade might be done to Russia and to the Danubian districts, for though prices in these parts are lower than those quoted in Germany, Silesian ironmasters would find it pretty easy to sell largely to the above-named countries, only they do not, it appears, care for an extended foreign business just now, a good many of them being hardly able to satisfy inland consumers.

A very strong tone is maintained throughout the coal trade in Germany, demand being exceptionally good for engine as well as house coal.

In Austria the position of the iron industry remains pretty favourable on the whole, only the continued underquoting of the Hungarian works prevents the Austrian makers and dealers from getting all the profit they might derive from the present improved state of affairs. In Hungary the iron market is in a state of extreme dulness or stagnation almost; bars are entirely neglected, and so one large mill has resolved to produce girders instead, but there is very little chance of finding a good market for them in Hungary, where the building departments are weakly employed, and so they will have to try and sell them in Austria. There has already been talk of the Austrian girder convention contemplating a reduction in their prices in case the Hungarian works should continue to underquote.

Demand for coal and coke increases in Austria; the sugar mills begin to cover their requirements, and many other mills and factories are also putting in large stores. Consumption is, on the whole, higher than output; and so it has happened that here and there orders given out by dealers had to be refused. In the Bohemian brown coal districts, the insufficient number of load wagons has caused considerable inconvenience lately, and last week a restriction in output has in some instances been the consequence. Raw and manufactured iron meets with a continued

exceptionally good demand in Belgium; consumption is, in most cases, in excess of the output, and the tendency of prices remains very firm. In the Belgian coal trade business is full and satisfactory. Prices are considered remunerative.

The French iron and steel industries are very actively employed. There is much life stirring in the building and engineering branches, and the inquiry this week and last has been more pressing than ever. The French coal trade has likewise been improving in all branches.

Statistic figures state value of general import to France, during the first nine months of present year, to have been 3,144,823,000f., against 3,417,363,000f. for the corresponding period last year. Value of export, on the other hand, rose from 2,514,342,000f. last year to 2,840,031,000f. this year.

The German coal trade shows more briskness from week to week, but the difficulty to secure supplies is likewise increasing. The prices for coal and coke for April, 1900, have now been fixed, and are considerably higher than those for last year, but there is an abundance of orders nevertheless. Latest quotations are, for best steam coal, M. 1 to 16 p.t.; anthracite, M. 19.50 to 21 p.t.; blast furnace coke, M. 150 to 160 p.t.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, October 20th.

THE badly oversold condition of the iron and steel markets of the country gives a dull appearance to things. Consumption, however, is greater than ever, and consumptive requirements are on the increase. A great many buyers who two months ago endeavoured to place contracts are now in the market trying to protect themselves, but are meeting with very little success because of the unwillingness of so many makers of pig iron or finished material to contract so far ahead. It is stated that 75 per cent. of the furnace capacity is sold up to June, 1900; be this as it may, it is certain that blast furnaces throughout the country are sold very far ahead, and their managers are unwilling to go much farther at present. There are rumours of a reaction in iron, and the possibilities of such a result are being watched very closely indeed. Nothing has yet occurred upon which to base an intelligent opinion. The Carnegies are making haste to start their two new furnaces of 1000 tons per day capacity each. Rumours are rife that three to four other big blast furnaces will be undertaken by other corporations. The fact is, that pig iron-making capacity is clearly behind the probable requirements, and the chances are that within the next three or four months half a dozen new furnaces will be started, and preparations will be made to commence their construction this spring. The same is true of steel mills. Four or five are now projected in different parts of the country, and the capital is provided. Work on these new enterprises will begin during the winter. Already contracts for certain kinds of machinery have been quietly placed.

The extraordinary demand for machinery has crowded our larger machine works to such an extent that they are now planning extensions. Difficulties are encountered in finding sufficient skilled labour. Wages are advancing, and there are rumours of strikes in several trades, but these will not occur until the spring. The Carnegie Company is credited with an intention to make still further improvements than those heretofore announced. The Republic Iron and Steel Company, which controls some thirty-six or thirty-seven mills, is credited with a purpose of building three additional mills, and are consolidating several of their smaller mills by which their capacity will be very greatly increased. No changes in quotations of crude or finished material have been placed within a few days, but it is known that small buyers have been paying more than current quotations for prompt deliveries. Ocean tonnage is advancing in value on account of the Transvaal war. It continues to be the policy of large steel consumers to place contracts far ahead, and several leading authorities in this city have stated within the past twenty-four hours that some of the largest contracts for steel ever heard of will be placed before the middle of November for delivery the latter part of next year. Nearly all the larger concerns are pretty well supplied up to June next; despite rumours to the contrary, everything indicates a steady advance in demand, and the inference is that prices will harden, if not advance at least 10 per cent. within thirty days. Advices from Chicago show that consumers there are very urgent in their demand, and a great many of them are running out of material. Advices from St. Louis show a very excited market, owing to short supplies. Reports from Alabama show a heavy demand for crude iron. Telegraphic advices from Pittsburgh show that a large amount of new business for iron is in sight. Reports from Wheeling and Cleveland show a similar state of things. The uncertainty regarding the price of ore next year is interfering with more or less business. When prices were fixed for ore last year, pig iron was 9 dol., but with pig iron now more than double that price, it is uncertain what the ore producers will do. They propose to take advantage of the opportunity and get the very best for their material.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal—the demand for all kinds is very great. Prices have considerably advanced, with every prospect of going higher. House coal in good request, and prices firm. Steel and ironworks are well employed, especially for tin bars and finished goods. Tin and copper are both easier than last week's quotations. Exports for week ending October 21st were:—Coal: Foreign, 55,893 tons; coastwise, 20,910 tons; rails, 500 tons; patent fuel, 3000 tons. Imports for week ending October 24th were:—Iron ore, 11,480 tons; pig iron, 4152 tons; pitwood, 2350 loads; one cargo deals.

Coal: Best steam, 13s. 9d. to 14s.; seconds, 13s. 6d.; house coal, best, 13s. 6d.; dock screenings, 8s. 9d.; colliery small, 8s. to 8s. 3d.; smiths' coal, 9s. Pig iron: Scotch warrants, 70s. 9d.; hematite warrants, 76s. 9d. f.o.b. Cumberland; Middlesbrough, No. 3, 69s. 8d. prompt. Iron ore: Rubio, 17s. to 17s. 6d.; Tafna, 15s. 9d. to 16s. Steel: Rails—heavy sections—£6 10s. to £6 15s.; light do., £7 15s. to £8 f.o.b.; Bessemer steel tin-plate bars, £6 5s.; Siemens steel tin-plate bars, £6 7s. 6d., all delivered in the district cash. Tin-plates: Bessemer steel, coke, 15s. 6d. to 15s. 9d.; Simons—coke finish—15s. 9d. to 16s. Pitwood: 18s. 6d. to 19s. London Exchange Telegram: Copper, £73 7s. 6d.; Straits tin, £140. Freights steady.

DEATH OF MR. GRANT ALLEN.—We regret to have to announce the death, at the early age of 51, of Mr. Grant Allen. Although his reputation is principally that of a novelist, it ought not to be forgotten that he was a man of very considerable scientific attainments; and he was a most delightful writer on botany and entomology. Several years ago he wrote a somewhat important book on "The Metaphysics of Force and Motion," which has been favourably reviewed in THE ENGINEER.

TRADE AND BUSINESS ANNOUNCEMENTS.—Mr. W. H. Badams, after nine years of association with Mr. A. E. W. Gwyn, has, owing to Mr. Gwyn's retirement, purchased the business, including the goodwill, and has taken offices at 75A, Queen Victoria-street.—Chance Brothers, of Birmingham, have, we understand, purchased from Dr. Purves, of Edinburgh a licence for Chili for his recently patented lighthouse apparatus, described in papers read before the Institute of Civil Engineers, and the Royal Society of Edinburgh, by Dr. Purves. Messrs. Chance have just completed the first of a series of this apparatus for the Chilean Government.—We are informed by Mr. J. K. Stothert that he is about to enter the business of G. K. Stothert and Co., of Bristol, and that on and after November 1st his address will be Southbank, Goldney-road, Clifton, Bristol.

ENGINEERING NOTES FROM SOUTH AFRICA.

(From our own Correspondent.)

JOHANNESBURG, October 2nd.

THE Cape Government Railways Department is taking to itself some credit for having installed a system of hydraulically-worked levers at the new signal-cabin at Salt River. It is stated that this is found a very effective labour-saving arrangement.

The question of the defence of the Cape ports has been discussed in the Colonial Legislature this week. Parliament has declined to sanction any expenditure for the fortification of Port Elizabeth and East London. This policy is based upon the very rational theory that the safety of these ports is simply a question of Great Britain's command of the sea. It would, it is considered, only be a useless outlay to provide them with guns sufficient to protect them against a roving cruiser, since if they ever became open to the visits of such a vessel they would be open to those of a far more formidable force. While this view will meet with the approval of naval experts in England, it illustrates what an extremely wide demand colonial ideas make upon the capacities of the Imperial Navy, and it shows that the Cape's contribution of £30,000 a year was not intended as a barren display of patriotic sentiment. Table Bay is, of course, in a different position to the two more westerly ports, inasmuch as it would possess enormous importance to Britain in the event of war, and would certainly be a chief point of attack from an enemy. The Imperial authorities have spent large sums in mounting heavy guns at various points, and the Colonial Government has co-operated with them by establishing a corps of local artillery volunteers to man the batteries. This week a sum of £17,000 was voted towards the expenses of these volunteers. The naval authorities should, therefore, feel encouraged to put the defences of the Cape Peninsula upon a footing commensurate with their importance to the Empire.

As I write war between Britain and the Transvaal appears inevitable, and it is even reported that shots have been exchanged on the Natal frontier. It is generally thought that the Boers will rely upon their familiar tactics of fighting behind cover, and that the fate of the British forces will depend entirely upon the skill with which the artillery is employed to dislodge them and to cover the advance of cavalry. On the other hand, the Boers for the first time in their history are fighting with artillery, and it is conceivable that their confidence in this arm may lead them to assume the offensive. It is stated that the German officer who has directed the formation of the Transvaal Staats Artillerie resigned upon the first rumours of war, and that he does not think highly of the efficiency of the force. In particular, he is said to have declared that the ammunition is defective. All the Transvaal guns are modern, but they are of very varied type, including pieces from Armstrong, Krupp, Creusot, and Vickers. The rifle is the Mauser—five-shot magazine—but it is said to act anything but smoothly, owing to the "turn" of the rifling being too great for the length of the barrel. It is probable that a good deal of railway construction will have to be done by the British forces, and already a reversing line over Laing's Nek has been got ready for the laying of the rails.

Chairmen of Witwatersrand gold mining companies, continue to plead to mechanical inventors for the production of a machine rock-drill that will work with economy in narrow widths of reef. At the meeting of the Simmer and Jack mine this week it was stated that the scarcity of native labour had enforced the general employment of machine drills in the stopes, that this had involved an extra cost of 2s. per ton of ore mined, and that that represented a total extra outlay on the year's working of £30,000. However, the average working expenses per ton of ore mined were reduced from 23s. 7d. in 1897 to 20s. 9d. in 1898. The economy is largely due to the enormous scale upon which operations are conducted at the Simmer and Jack. The mine now has 280 stamps at work, and forty stamps are being added to this huge battery.

LAUNCHES AND TRIAL TRIPS.

BARENDZ, trawling steamer; built by, Cochrane and Cooper, Limited; to the order of, Van Vliet; dimensions, 115ft. 4in., 21ft. 6in., by 11ft. 6in.; engines, triple-expansion, 13in., 21in., 34in., by 24in.; pressure, 180 lb.; constructed by, Sir Christopher Furness, Westgarth, and Co., Limited; launch, October 7th.

NEWARK; built by, Northumberland Shipbuilding Company, Limited; to the order of, J. J. and C. M. Forster; dimensions, 220ft., 32ft. 6in., 17ft. 4in.; to carry, 1500 tons deadweight; engines, triple-expansion, 18in., 30in., 49in., by 33in.; pressure, 180 lb.; constructed by, J. P. Rennoldson and Sons; trial trip, October 7th.

PORTUGAL, mail and passenger steamer; built by, Sir Raylton Dixon and Co., Limited; to the order of, Empresa Nacional de Navegacion a Vapor, Lisbon; dimensions, 377ft., 45ft. 6in., 29ft. 9in.; to carry, 5000 tons deadweight; engines, triple-expansion, 3000-horse power; constructed by, Thomas Richardson and Son, Limited; trial trip, October 14th, 14 knots.

MARIPOSA, steel screw steamer; built by, Joseph L. Thompson and Sons, Limited; to the order of, T. Hogan and Sons, Bristol; dimensions, 390ft., 49ft. 9in., 30ft. 8in.; engines, triple-expansion, 25in., 43in., 73in., by 48in., pressure, 200 lb.; constructed by, Blair and Co., Limited; launch, October 17th.

EVERINGHAM, steel screw steamer; built by, Blyth Shipbuilding Company, Limited; to the order of, Alex Meek and Sons, of Goole; dimensions, 337ft., 47ft., 24ft. 10in.; engines, triple-expansion; constructed by, Blair and Co., Limited; launch, October 18th.

GLENROY, steel screw steamer; built by, Wm. Gray and Co., Limited; to the order of, Livingston, Conner, and Co., of West Hartlepool; dimensions, 329ft., 46ft., 23ft. 6in.; to carry, 4850 tons deadweight; engines, triple-expansion,

23in., 36in., and 62in. by 30in.; pressure, 160 lb.; full cargo of coals; trial trip, October 3rd; 10 1/2 knots.

GADSBY, steel screw steamer; built by, Ropner and Son; to the order of, R. Ropner and Co.; dimensions, 325ft., 48ft., 24ft. 3in.; to carry, 5280 tons deadweight; engines, triple-expansion, 1100-horse power; constructed by, Blair and Co., launch, October 19th.

BRUNSWICK, steel screw tug boat; built by, John Jones and Sons; to the order of, Alexandra Towing Company; launch, October 21st.

SHEPPY ALLISON, steel screw steamer; built by, Wm. Gray and Co., Limited; to the order of, J. S. Allison and Co.; dimensions, 312ft., 43ft., 22ft. 3in.; engines, triple-expansion, 22in., 35in., 59in., by 39in.; pressure, 160 lb.; constructed by, Central Marine Engine Works; trial trip, October 21st; 11 knots.

BYLANDS; built by, Ropner and Son; to the order of, Jos. Wilson and Co.; to carry, 5600 tons deadweight; engines, triple-expansion, 1250-horse power; constructed by, Blair and Co., Limited; trial trip, October 21st; 11 knots.

ETRURIA, steel screw spar deck type; built by, Craig, Taylor, and Co.; to the order of, A. C. de Freitas and Co., of Hamburg; dimensions, 274ft., 35ft., 23ft. 8in.; engines, triple-expansion, 22in., 35in., and 59in., by 39in. stroke; pressure, 160 lb.; constructed by, T. Richardson and Sons, Limited; launch, October 19th.

ORO, steel screw steamer; built by Sir Raylton Dixon and Co., Limited; to the order of, Gellatly, Hankey, and Co.; dimensions, 352ft. 4in., 47ft., 25ft. 9in.; to carry, 5300 tons deadweight; engines, triple-expansion, 25in., 40in., 66in., by 45in.; pressure, 180 lb.; constructed by, Sir C. Furness, Westgarth, and Co., Limited, Howden's draught; launch, October 21st.

SAXOLEINE, oil tank steamer; built by, Sir W. G. Armstrong, Whitworth, and Co.; to the order of, Flannery, Baggallay and Co.; dimensions, 347ft., 45ft., 29ft. 6in.; to carry, 5500 tons deadweight; engines, triple expansion; constructed by, Wallsend Slipway and Engineering Company, Limited; trial trip, October 22nd.

KRUPP ARMOUR AND CONGRESS.

It will be remembered that at the close of the last Congress it was decided that the contract for the new battleships and armoured cruisers should not be let, unless their armour could be secured at or under the price of 400 dol. a ton. It is well understood that the undoubted superiority of the Krupp armour over that manufactured by the Harvey process will render its adoption for future warships a positive necessity, unless, indeed, we are prepared to be left far behind other nations in the defensive qualities of our ships. Those who have any professional knowledge of the question have been at a loss to understand the exact grounds on which the small clique who are responsible for this disastrous deadlock in our naval construction arrived at their arbitrary figures, but anyone who has even a general knowledge of the state of the art knows that any firm that should undertake to produce and sell the new Krupp armour at 400 dol. a ton would soon find itself reduced to insolvency.

It is probable that by this time the United States Government is in possession of a complete statement of the facts of the case, prepared by Krupp, the great inventor and manufacturer, in which he deals with the question of price, and proves that the high cost of his armour is amply justified by the consideration of the costly plant and methods involved in its manufacture. We understand that the statement contains detailed information as to the armour-plate factory at Essen, in which it is shown that the total cost of the installation up to date has been no less than 5,000,000 dol. On the other hand, the great length of time necessary for the process of cementation, not to mention the slow machining of the armour plate, brings down the annual production to a maximum of 6000 tons. It is stated by Krupp that if the same amount of capital had been invested in a rail plant, the output would have been considerably over 100,000 tons. From this he draws the conclusion that for capital charges the price for armour plate ought to be vastly greater per ton. Another and equally weighty consideration is that the improvements in the manufacture of armour plate follow each other with such rapidity, and are often of such a radical nature, that the period during which any new and costly plant may be worked at a profit is liable to be of very short duration. For instance, it may be mentioned that it is only seven years since the Harvey process, which is now practically obsolete, was tested on European proving grounds; and while it is true that the Krupp process is essentially a development of Harvey's process, there is always the possibility of the introduction of a new system that will render the existing plant partially, if not altogether, obsolete.

We sincerely trust that when Congress meets again and takes this matter under consideration, the members who have hitherto busied themselves with this question will endeavour to look upon it from a broad and patriotic standpoint. In the first place, the price asked by Krupp is not excessive, and is being willingly paid by the European makers. But even if it be excessive, we had better bear the comparatively slight increase of cost rather than "hold up" indefinitely the work of constructing our new navy. To do this is to be guilty of the stultification which is well described in the old adage which speaks of the folly of "cutting off one's nose to spite one's face."

We have, indeed, heard it whispered that the 400 dol. per ton restriction was imposed with the clear knowledge of the facts that we have stated above, and that it was done for the express purpose of delaying the battleship and armoured cruiser construction at a time when some of our shipbuilding firms were not prepared or did not wish to take up any new naval construction. We prefer charitably to hope that the members who were responsible for this "hold-up" were the victims of short-sightedness or lack of information. That any member of Congress could be guilty of such a culpable act as that of imperilling the safety of the country in the interests of a particular industry is too shocking a thought to be entertained without the most positive proof.—Scientific American.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

13th October, 1899.

- 20,517. BOOT-CLEANING MACHINE, E. Glaser, Berlin.
20,518. ARTIFICIAL MARBLE, S. Weill, Berlin.
20,519. COLLAPSIBLE FOLDING HAMPER, W. P. Ellmore, London.
20,520. MUD REMOVER, F. Fidler, Coalville, Leicester-shire.
20,521. COUPLING TRUCKS, G. Ashworth and J. Taylor, Manchester.
20,522. GAS LAMPS, H. Tee, Liverpool.
20,523. COUNTER SEATS, R. H. Speak, Halifax.
20,524. STEAM GENERATORS, J. G. A. Kitchen, Manchester.
20,525. VASELINE, W. E. Heys.—(J. Zibell and the Firm of J. Zibell and Co., Austria.)
20,526. PATTERN SURFACES OF LOOMS, D. M. Scaton, Bradford.
20,527. HOLDER FOR CARRIAGE LAMPS, W. Bobbett, Teignmouth, South Devon.
20,528. CHAINS, G. E. Rees, Bolton.
20,529. MARINE FOG SIGNALLING, J. R. Wigham, Dublin.
20,530. OUTDOOR SEATS, J. Harwood, Manchester.
20,531. DRYING OF WITHERING APPARATUS, G. W. Sutton, Chelmsford.
20,532. FORK OR SHOVEL HANDLES, T. Timmings, Stourbridge.
20,533. PUMPS, R. McGregor, Glasgow.
20,534. ELECTRIC LIGHTING CEILING ROSE, T. S. McLaren, Glasgow.
20,535. DOUBLE-BARREL GUNS, W. H. Brighton, London.
20,536. BOATS AND WATER ROUNDABOUTS, J. W. Ellis, London.
20,537. BRAKES, C. W. Hathaway, Coventry.
20,538. APPLIANCE FOR ADJUSTING MIRRORS, E. C. Dryden, Glasgow.
20,539. SHAFT PROTECTORS, H. Haddon, London.
20,540. LOCKING RAILWAY CARRIAGE DOORS, W. H. Taylor, Glasgow.
20,541. COMBINATION STETHOSCOPE, F. Franke, Glasgow.
20,542. STEAM GENERATORS, D. Croll, Glasgow.
20,543. CLEANING AND SEPARATING PEAS, W. White and J. Vickers, Leeds.
20,544. ELECTRIC BELLS, R. Bowman, Crumlington.
20,545. ELASTIC TIRES, R. Twigg and H. Morris, Birmingham.
20,546. CYCLE LUGGAGE CARRIERS, B. Hawkins.—(C. B. Oakley, India.)
20,547. PHOTOGRAPHIC APPARATUS, A. L. Adams, London.
20,548. MAKING CELLULAR TIRES, W. F. Beasley, London.
20,549. ELECTRIC INCANDESCENT COLOURED LAMP, A. L. Adams, London.
20,550. PENHOLDER, F. H. Rosher, Croydon.
20,551. RUBBER STAMPS, T. Brown, Fisherton, Salisbury.
20,552. PROTECTOR FOR HAT-PIN POINTS, J. Donald, Dundee.
20,553. SHUTTER FOR LOOMS, W. Fielding, Manchester.
20,554. MANUFACTURE OF DECORATIVE CHESTS, O. Rahn, Berlin.
20,555. A SCORING GAME, G. S. Tennings, Manor Park, Essex.
20,556. ROTARY ENGINE, A. H. Shoemaker, London.
20,557. MACHINE FOR GRINDING LIMB, F. E. Whitham, London.
20,558. BRAKES, E. W. Bohle and J. A. Phillips, Birmingham.
20,559. FOOT BRAKES FOR CYCLES, G. W. Bullen, London.
20,560. DUPLEX PUMPS, J. Shepherd and E. N. Banks, London.
20,561. POULTRY HOUSES OF COOPS, A. Powell, London.
20,562. BICYCLE FREE-WHEEL GEAR, R. W. Wilson, Newcastle-on-Tyne.
20,563. MACHINES FOR PACKING GOODS, A. J. Boulit.—(J. Castelli, Turkey.)
20,564. SEWING MACHINES, T. J. Roome and W. Graff, London.
20,565. PNEUMATIC TIRES, J. and H. Jelley, London.
20,566. SLEEPING BAGS, F. J. Stohwasser and G. B. Winter, London.
20,567. PRODUCING ACETYLENE LIGHT, T. H. Lewis, Glasgow.
20,568. FREE WHEELS FOR CYCLES, P. B. Douglass and W. F. Jefferies, London.
20,569. IMITATION LEATHER MATERIALS, F. S. D. Scott, London.
20,570. IGNITION ARRANGEMENT FOR GAS ENGINES, F. W. Lanchester, London.
20,571. SEWING MACHINES, W. S. North, London.
20,572. WATER-TIGHT PLUNGER CONTACT, H. Oppenheimer.—(Actien-gesellschaft Mix and Genest, Germany.)
20,573. STUFFING-BOX, J. Stumpf, London.
20,574. CYCLE BRAKES, P. B. Douglass and W. F. Jefferies, London.
20,575. SEPARATING ANIMAL CARCASSES, A. von Podewils, London.
20,576. MASKING HORSES' EYES, M. Kart, London.
20,577. CAN OPENER, E. H. Harberd, London.
20,578. SACKS, O. Stuart, Liverpool.
20,579. LIFE-BELTS, M. Christoph and J. Walch, Liverpool.
20,580. IMPRESSED WOOD PANELS, W. P. Thompson, Liverpool.
20,581. LIDS FOR KETTLES, F. G. Fox, London.
20,582. FLY TRAP, T. Ferguson, London.
20,583. TREATING ORES, H. H. Lake.—(M. Costello, United States.)
20,584. BRAKE BLOCKS FOR VEHICLES, F. R. C. Joyce, London.
20,585. FIRE-ESCAPES, J. E. Young, London.
20,586. REGULATING BOILER FEED-WATER, E. Latham, London.
20,587. ELECTRIC CONDUIT RAILWAYS, H. S. Maxim, London.
20,588. BOXES FOR MATCHES, L. Tallodi and S. Kis, London.
20,589. CRANK, A. E. Madd and H. F. Young, London.
20,590. PHOTOGRAPHIC CAMERAS, W. Patterson, London.
20,591. APPARATUS FOR SAVING LIFE AT SEA, A. J. Wilkinson, London.
20,592. HYDRAULIC RAMS, J. M. Kline and S. A. Wetzel, London.

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- 20,593. JOINTS FOR GLASS, A. G. Southby, London.
20,594. WICK LAMPS, J. Watts and J. Woodward, Birmingham.
20,595. JOINTS FOR CABLES, T. Herwood and The Reason Manufacturing Company, Limited, Brighton.
20,596. FASTENING CARDBOARD BOXES, Baron Elkan and C. A. Bartlett, London.
20,597. KEEPING VELOCIPED CHAINS CLEAN, G. J. Geary, Sale, Cheshire.
20,598. INTERNAL COMBUSTION ENGINES, J. A. Ageron, London.
20,599. DROP-SIDE COTS, J. E. Hoskins, Birmingham.
20,600. PROFILING MACHINES, T. Webster and A. E. Bennett, Birmingham.
20,601. SECTIONAL WARPING MACHINES, J. H. Stott, Manchester.
20,602. GAS ENGINES, A. G. Melhuish, London.
20,603. INSERTING TUBES INTO BOTTLES, W. Denham, Halifax.
20,604. GAS-HEATED WATER HEATERS, E. W. T. Richmond, Liverpool.
20,605. PREVENTING ELECTRIC SPARKING, J. K. Stanley, Kilderminster.

- 20,606. RAISING, &c., MATERIALS, H. A. L. Barry, London.
20,607. TRANSLATING CABLE SIGNALS, J. P. Gorton, Weston-super-Mare.
20,608. AUTOMOBILES, J. T. Wride, Birmingham.
20,609. LOOMS, D. M. Scaton, Bradford.
20,610. SPANNER, H. J. Bubb, Glasgow.
20,611. LOOMS, R. L. Hattersley and S. Jackson, Keighley.
20,612. SLEEVE BOARD OF IRONING STAND, S. Curral, Reading.
20,613. MANUFACTURING WOOLY FIBRE, A. Tolhausen, Manchester.
20,614. REGISTERING BRACES, H. Eldridge, St. Margaret's, Middlesex.
20,615. ELECTRIC SAFETY APPARATUS FOR LIFTS, J. Bush, London.
20,616. MIRROR, W. A. Jackson, Whitley, R.S.O., Northumberland.
20,617. APPARATUS FOR FASTENING ENVELOPES, W. H. Scratton, London.
20,618. METAL CASKS, E. Redman, Leeds.
20,619. PATCHING MATERIAL FOR TIRES, E. B. Raper, York.
20,620. GARDEN STAKE, R. Hooker, Exeter.
20,621. PROJECTING FILM TITLES, W. C. L. Holland, London.
20,622. ACETYLENE GAS GENERATORS, P. Schreck, Manchester.
20,623. COMBINED FAN AND LOBNETTE, H. Supthut, Glasgow.
20,624. SHUTTLE GUARDS, J. and F. H. Gleave, Manchester.
20,625. GAS ENGINES, W. R. Wynne, London.
20,626. STERILISED MILK POWDER, C. Janson, London.
20,627. ROOF BOARDS, C. Schoutup, London.
20,628. HANDLES FOR CYCLE HANDLE-BARS, F. A. Briggs, London.
20,629. PICTURE POSTCARDS, R. W. Koehler, London.
20,630. DRYING CELLULOSE PRODUCTS, M. Fremery and J. Urban, London.
20,631. DEMONSTRATING THE MOVEMENT OF THE EARTH, J. Stephen, London.
20,632. ROAD-BREAKING MACHINES, H. F. Ruddy, London.
20,633. GAITERS, T. W. Hill, London.
20,634. BASKETS, J. Dunning and H. Colignon, Liverpool.
20,635. KILN, W. Davis-Douglas, W. Chicago, U.S.A.
20,636. HOOKS FOR WATCH CHAINS, W. Grotzinger, London.
20,637. PORTABLE FREIGHT CONVEYORS, W. L. McCabe, Liverpool.
20,638. STEAM TRAPS, J. E. Slack, Manchester.
20,639. RAILWAY SIGNALLING, T. Shield, W. Marsden, and W. Blairstow, London.
20,640. PORTABLE CHAFF-CUTTERS, R. Maynard, London.
20,641. INCANDESCENT GAS BURNERS, W. MacKean, London.
20,642. CAVALRY AMBULANCE, H. G. Hathaway, London.
20,643. REPRODUCING DESIGNS ON FABRICS, F. Dommer, London.
20,644. FACING POINTS FOR TRAMWAYS, G. Flett, London.
20,645. CAMERA-SCREW HOLDER, A. W. Lonsdale, London.
20,646. RETAINING CUFFS IN POSITION, E. F. K. Byrnes, London.
20,647. TOBACCO PIPES, H. H. Frith, London.
20,648. FILLING BOTTLES, T. W. Bamford, London.
20,649. RESULT INDICATOR, R. Molyneux and F. J. Cox, Liverpool.
20,650. JACKS, C. Portway and J. T. Graham, London.
20,651. CYCLE RIM BRAKE, A. Windrow, Levenshulme, Lancs.
20,652. VEHICLE COUPLINGS, J. H. Gameson and W. K. Powell, London.
20,653. HORSESHOES, E. Tüchler and L. R. Bonhertz, London.
20,654. FUEL COMPOSITION, L. J. Davies, London.
20,655. FORMING JOINT ENDS, The Albion Clay Company, Limited, and R. Lawton, London.
20,656. TREATING CONDENSED FUMES, F. Ellershausen, London.
20,657. SAFETY DOOR FASTENINGS, J. L. Labbé, London.
20,658. PRODUCING COKE GAS, P. Naef, London.
20,659. PRODUCING GAS, P. Naef, London.
20,660. PRODUCING GAS, P. Naef, London.
20,661. COMBINING GLASS WITH STEEL, La Société Anonyme de Commentry-Fourchanbault et Decazeville, London.
20,662. STOPPERING BOTTLES, M. G. Kruse, London.
20,663. CRUCKS, Smith and Coventry, Limited, W. D. F. Smith, and T. Coventry, Manchester.
20,664. GAS ENGINES, H. H. Lake.—(Standard Automatic Gas Engine Company, United States.)
20,665. EXPLOSION MOTORS, G. Richard, London.

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- 20,666. SWITCHES FOR ELECTRIC MOTORS, R. Dobson, Salford.
20,667. WATERPROOFING PAPER, E. C. Staples, F. Greenwood, W. Brearley, and D. Woodhead, Leeds.
20,668. VAPORISING FLUIDS BY ELECTRICITY, R. C. Sayer, Bristol.
20,669. RIMS FOR TIRES, J. Taylor, London.
20,670. CLOTHES HORSES, A. E. Wynn, Knaresborough, Yorks.
20,671. EXHAUST VALVES FOR ENGINES, C. H. Guest, Derby.
20,672. BUSH FOR WHEEL AXLES, G. A. Russell, Newport, Mon.
20,673. LOOM JACQUARDS, G. H. Hodgson and W. Tetley, Halifax.
20,674. OINTMENT INJECTOR, A. Smith, Leeds.
20,675. PREPARING AND SPINNING COTTON, J. Stott, Manchester.
20,676. CONE-DRIVING MECHANISM, J. Stott, Manchester.
20,677. PISTON RING, R. J. Houghton, Widnes.
20,678. SWITCH FOR ELECTRICAL MACHINES, R. J. Houghton, Widnes.
20,679. EMBOSSED OR RELIEF EFFECTS, J. Stephen, London.
20,680. VALVE, E. Grimault, Stockton-on-Tees.
20,681. DISTRIBUTING DEODORISING LIQUIDS, J. H. Williams, Liverpool.
20,682. SAFETY LETTER SEAL, J. Greiner, St. Leonards-on-Sea.
20,683. AIR COMPRESSORS, R. J. W. Reinhard, Liverpool.
20,684. WATER-CLOSETS, D. G. Brighton and R. Ewing, London.
20,685. MILK SEPARATORS, W. P. Thompson.—(G. Daseking and M. Henze, Germany.)
20,686. SALEMAN'S COPYING BOOKS, J. F. Laning, London.
20,687. FIRE KINDLER, C. A. Allison.—(W. H. and F. H. Marston, United States.)
20,688. BICYCLE FRAME CONSTRUCTION, J. Long, London.
20,689. EXTINGUISHING ELECTRIC LIGHTS, F. W. Smith, London.
20,690. GAS FOR OBTAINING LIGHT, J. Wilkinson, London.
20,691. BRAKES FOR VEHICLES, &c., W. Ford, Birmingham.
20,692. GUARD NOZZLE FOR "BEER" TAPS, A. Hughes, Reading.
20,693. UMBRELLAS, A. von Loepfer, Dundee.
20,694. STEERING GEAR, J. E. Liardet, London.
20,695. PRODUCING IMITATION PAINTINGS, R. Backhaus, London.
20,696. COUPLING, F. O. C. Prince and C. E. Monkhouse, London.
20,697. SHOW CASE AND ADVERTISING DEVICE, J. Fuller, London.
20,698. COIN TESTER AND PENCIL HOLDER, G. Bakewell, London.
20,699. SOAP, H. Iriban, London.

- 20,700. CHLORAMMONIUM, C. Wülfing, Old Charlton, Kent.
- 20,701. PHARMACEUTICAL COMPOUNDS, H. E. Newton.—(The Farbenfabriken vormals Friedrich Bayer and Co., Germany.)
- 20,702. WAGON COUPLINGS, E. Richardson and W. Trow, Birmingham.
- 20,703. HYDRAULIC AIR COMPRESSORS, W. J. Linton, London.
- 20,704. SEWER CHOKE ALARM and DETECTOR, N. Barnett, London.
- 20,705. ELECTRICALLY-ENERGISED CLOCKS, G. D. Granger, London.
- 20,706. FISHING-ROD REST, O. Grumpt, London.
- 20,707. HORSESHOES, E. Tüchler and L. R. von Heiz, London.
- 20,708. CAMP BEDSTADS, O. Imray.—(G. F. Beys, India)
- 20,709. WASH HAND STAND, O. Imray.—(G. F. Beys, India)
- 20,710. COIN-FREED FLUID APPARATUS, W. Staples, London.
- 20,711. FASTENERS FOR STRAPS, T. S. Grace, Kingston-on-Thames.
- 20,712. PROCESS FOR THE PRODUCTION OF DISINFECTING POWDER, H. H. Lake.—(Stackmann and Retschky's Chemical Works, Germany.)
- 20,713. MOTOR ROAD VEHICLES, &c., G. Richard, London.
- 20,714. AMMUNITION, J. L. Brewer, London.
- 20,715. FREE WHEEL and BRAKE, R. C. Pritchard, London.
- 20,716. SAFETY-PINS, H. H. Taylor, London.
- 20,717. POSTCARD, P. Ehmertahl, London.
- 20,718. ROTARY EXPANSION ENGINE, C. A. Schopper and A. W. H. Röder, London.
- 20,719. CLIP DEVICES, B. E. Ellingham, London.
- 20,720. ELECTRIC LAMPS, V. I. Feeny.—(Allgemeine Electricitäts Gesellschaft, Germany)
- 20,721. ROTARY PRESSES, J. L. Towner, London.
- 20,722. OPERATING SLIDE VALVES OF ENGINES, C. J. Simeon, London.
- 20,723. BOLTS, W. Doyle, jun., London.
- 20,724. GAME, D. Balsille, London.
- 20,725. STRETCHERS FOR BOOTS, &c., W. Belden, sen., London.
- 20,726. INDICATING APPARATUS FOR RACES, D. C. Carr, London.
- 20,727. HOOKS and EYES, H. T. A. Schulze, London.
- 20,728. VENETIAN BLINDS, F. T. Wonnacott and H. A. Kellaway, London.
- 20,729. SADDLES FOR CYCLES, A. Cuthbert, London.
- 20,730. PROTECTING RING FOR AIR INLETS, F. Knüttel, London.
- 20,731. CONTROLLING RAILWAY POINTS, P. Siefeldt, London.
- 20,732. ACCUMULATORS FOR MIXED FLUIDS, W. J. Cruyt, Liverpool.
- 20,733. COUPLINGS FOR RAILWAY WAGONS, T. Armstrong, Manchester.

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- 20,734. HOLDING CALCIUM CARBIDE, H. Salisbury, London.
- 20,735. SURGICAL COUCHES, J. R. Johnson, Richmond, Surrey.
- 20,736. CIGARLETTE CONNECTING TUBE, R. Marshall, London.
- 20,737. BOTTLE, A. A. Brandt, Weymouth.
- 20,738. CASE FOR BINDING PAPERS, P. W. Peckham, Leicester.
- 20,739. AERIAL or FLYING MACHINES, C. Armitage, Leeds.
- 20,740. SCREW PROPELLERS FOR STEAMERS, B. Jumeraux, Manchester.
- 20,741. SEATS FOR RAILWAY CARS, J. R. Grog, Manchester.
- 20,742. CONNECTING OUTLET PIPES, C. Taylor, Manchester.
- 20,743. GAS METERS, J. Tourtel.—(P. Rieter and H. Bauer, Germany.)
- 20,744. TREES FOR BOOTS and SHOES, F. Bowman, London.
- 20,745. PROCESS FOR PRODUCING SPIRITS, A. Kern, jun., London.
- 20,746. CYCLE BRAKES, J. B. Brooks and J. Holt, Birmingham.
- 20,747. RELEASING HORSES IN FIRE-STATIONS, C. P. Eggar, Glasgow.
- 20,748. WIRE CUTTERS FOR CHEESE, &c., J. Rowat, Glasgow.
- 20,749. SPRING SHOE BRAKE, J. F. Hammett, Exeter.
- 20,750. LOCOMOTIVE VEHICLE, C. H. Huntly, Portladies, Sussex.
- 20,751. STEERING GEAR FOR MOTOR CARS, E. Andreas, Manchester.
- 20,752. LIFE-SAVING GUARDS FOR TRAMCARS, W. Wilson and T. Bennett, Manchester.
- 20,753. GLOBES FOR INCANDESCENT GAS LIGHTS, S. Biheller, London.
- 20,754. BALL BEARINGS, A. T. Pryce, Birmingham.
- 20,755. CYCLES, J. G. Reeve, Birmingham.
- 20,756. ENVELOPE-MAKING MACHINES, A. J. Boul.—(S. Cupples, United States.)
- 20,757. ROLLER CLUTCHES, H. Jelley, London.
- 20,758. CLUTCHES, J. L. Sampson, London.
- 20,759. TREATMENT OF SEWAGE, T. J. Barnard, London.
- 20,760. NON-PUNCTURABLE TIRE, J. Muttitt, Enfield.
- 20,761. CURTAIN HOOK, G. C. Eaton, London.
- 20,762. CHAIN WHEEL DRIVING GEAR FOR CYCLES, F. W. Schroeder, J. H. Brodie, and P. W. Moran, London.
- 20,763. MACHINERY FOR SEWING NEEDLES, H. Milward and Sons, Limited, and S. Davis, London.
- 20,764. METALLIC HREL PLATES OF BOOTS, J. Cox, London.
- 20,765. MATCH-BOX COVER COMBINATION, J. F. H. V. Hoop, London.
- 20,766. PULVERISERS, C. K. Mills.—(The British Aero Pulveriser Company, United States)
- 20,767. PHONOGRAPHS, B. J. B. Mills.—(T. A. Edison, United States.)
- 20,768. MACHINES FOR SCREW CUTTING, E. Turner, London.
- 20,769. SPOOL CARRIERS FOR WINDING MACHINES, E. Greiff, Barmen, Germany.
- 20,770. PUZZLES, A. Hunt, London.
- 20,771. VARIABLE SPEED GEAR, R. J. Hutchinson, London.
- 20,772. GAME OF PUZZLE, J. A. Calantarients, London.
- 20,773. SUPPLY REGULATOR FOR GASES, S. Mühlenthal, M. Löwenthal, and T. Hahn, London.
- 20,774. SMOKING TUBES, J. M. Eder, London.
- 20,775. BABY COMFORTERS, C. W. Meinecke, London.
- 20,776. WATER HEATING FOR STEAM BOILERS, J. E. Carroll, London.
- 20,777. PAPER FILES, O. Skrebba, London.
- 20,778. VELOCIPEDS, H. G. B. Smith, London.
- 20,779. COVERS FOR THE CROSS HATCHES OF VESSELS, H. See, London.
- 20,780. DUST SHIFTER and BRUSH SAVER, A. Dockree, London.
- 20,781. FREE-WHEEL DRIVING MECHANISM, P. A. Tower, London.
- 20,782. LOCKS, J. Tourtel, London.
- 20,783. PNEUMATIC TIRES, The Rudax Pneumatic Tire Company, Limited, and L. Johnstone, London.
- 20,784. BOXES, A. V. Laden and R. C. D. Ortelli, London.
- 20,785. EXHAUSTING AIR FROM AIR-TIGHT RECEPTACLES, C. H. Boynton, London.
- 20,786. HAIR COMBS, H. Traud, London.
- 20,787. STRETCHING THE UPPIERS OF BOOTS, H. H. Lake.—(A. Seaver, United States.)
- 20,788. VOLATILISING MEDICAMENTS, V. Cervello, London.
- 20,789. MACHINE FOR RECORDING SOUND, E. R. Johnson, London.
- 20,790. FUSES FOR ELECTRIC CIRCUITS, A. C. F. Webb, Liverpool.
- 20,791. EXCAVATING APPARATUS, J. Glover, Manchester.

- 20,792. CARBURETTING OF ENRICHING GAS, W. Irwid, Manchester.
- 20,793. GAS ENGINES, J. Richardson and F. S. Highton, London.
- 20,794. BOTTLES FOR CONTAINING INK, R. Thompson, London.
- 20,795. PRINTING PHOTOGRAPHIC PLATES, J. S. Duncan, London.
- 20,796. WINDOW SASHES and SHUTTERS, G. Barnes, London.
- 20,797. PRINTING FROM HALF-TONE BLOCKS, C. Swan, London.
- 20,798. BEVELS FOR BUILDERS and CARPENTERS, J. B. House, London.
- 20,799. FILLING BOTTLES, H. R. Wild and A. T. Smith, London.
- 20,800. TRUNKS, J. Foot, London.
- 20,801. HOISTS, W. L. Wise.—(The Empire Engine and Motor Company, United States.)
- 20,802. APPARATUS FOR DELIVERING LIQUIDS, The General Automatic Delivery Company, Limited, H. W. Phipps, and C. C. Cooper, London.
- 20,803. ELECTRICITY METERS, The British Thomson-Houston Company, Limited.—(E. Thomson, United States.)
- 20,804. ROTARY TRANSFORMERS, The British Thomson-Houston Company, Limited, and H. M. Hobart, London.
- 20,805. A NEW GAME, H. Clifford, London.
- 20,806. NEW VALVE FOR AIR BRAKES, E. G. Shortt, London.
- 20,807. VALVES, P. Meehan and R. Gray, London.
- 20,808. CASTING METALS, W. J. Patterson, London.
- 20,809. FILTERING and MOULDING PRESSES, G. M. Donald, London.
- 20,810. REPRODUCING THE SHAPE OF THE HUMAN BODY, E. Danion, London.
- 20,811. GEARS FOR CYCLES, A. J. Boul.—(L. Stilmant, Belgium.)
- 20,812. WOOD-WORKING BRADAWLS, A. E. Pancroft, London.
- 20,813. APPARATUS FOR EXHIBITING PHOTOGRAPHS, R. Krayn, London.
- 20,814. MUSICAL BOXES, H. H. Lake.—(B. H. Abrahams, Switzerland.)
- 20,815. TRANSMITTING POWER, C. McR. Tuttle and J. G. Accles, London.

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- 20,816. FLUID-PRESSURE MOTOR, J. Yates, London.
- 20,817. HISTORICAL PUZZLES, J. Robinson, Ipswich.
- 20,818. PRIMARY ELECTRIC BATTERIES, A. A. Beadle, London.
- 20,819. BATHS, T. W. Twyford, Birmingham.
- 20,820. PENCIL SHARPENER, E. R. Siegenthaler, Bradford.
- 20,821. EVEN-BALANCE WEIGHING MACHINES, J. White, Liverpool.
- 20,822. METALLIC BOX, A. Lovell and G. Fincken, Kingswood, near Bristol.
- 20,823. AIR VALVE, W. G. Heys.—(H. W. Davis and S. Hock, Austria.)
- 20,824. BICYCLES, E. B. Killen, Glasgow.
- 20,825. WASHING TEXTILE FABRICS, C. L. Jackson, Manchester.
- 20,826. BUTTER-PAT SHAPERS, C. Southall, Birmingham.
- 20,827. IMPROVING THE APPEARANCE OF FABRICS, E. Lodge and J. Frost, Huddersfield.
- 20,828. SLING SWIVEL FOR RIFLES, C. Moulder, Cheltenham.
- 20,829. BOOTS and SHOES, H. E. Brown, Dublin.
- 20,830. REVOLVING VENTILATOR COWLS, J. Maxton, Belfast.
- 20,831. MOUTHPIECE ATTACHMENTS, F. W. Kenny, Dublin.
- 20,832. LOMMETT TUBE, J. Page, Heywood, Lancs.
- 20,833. SAFETY APPLIANCE FOR TRAMCARS, H. A. Gradwell and J. Brook, Bradford.
- 20,834. COFF HOOK, H. Askew and T. Smith, Rotherham, Yorks.
- 20,835. SPINNING MACHINES, C. S. McCannan, Liverpool.
- 20,836. MULTIPLIABLE FITTING, D. Wilson and J. W. Graham, Huddersfield.
- 20,837. SPOUT or NOZZLE FOR BEER ENGINES, W. Oliver, London.
- 20,838. RIM BRAKES, J. Banton, London.
- 20,839. SHIPS or VESSELS, R. C. Thomson.—(F. R. Patey, Chili.)
- 20,840. MEASURING, &c., INSTRUMENT, W. D. Ford, Glasgow.
- 20,841. BOX FOR HOLDING CIGARETTES, F. M. Seddon, London.
- 20,842. GAME, J. G. Schüdel, Halifax.
- 20,843. WHEEL HUB FOR VEHICLES, L. Maigen, Darlington.
- 20,844. PILL, C. J. Innes-Baillie, London.
- 20,845. PILL, C. J. Innes-Baillie, London.
- 20,846. COIN-FREED AUTOMATIC MACHINE, E. Connor, London.
- 20,847. CLIP FOR CUFFS, W. B. Pinching and F. Proctor, London.
- 20,848. BROWN COLOURING MATTER, J. Y. Johnson.—(The Badische Anilin and Soda Fabrik, Germany.)
- 20,849. CHILD'S BIB, T. Southern.—(C. A. Blank, U.S.A.)
- 20,850. FILTRATION APPARATUS, A. and F. Smith and A. S. Muir, Birmingham.
- 20,851. BRAKES, E. de Pass.—(La Société Anonyme des Freins Automatiques "Stop," —)
- 20,852. CYCLE BRAKE, S. Breuze, London.
- 20,853. FLOWER HOLDER, C. A. Lees and C. E. Osman, London.
- 20,854. CIGAR and CIGARETTE HOLDER, J. Clarke, London.
- 20,855. BARREL BUNG, C. A. Raggio, London.
- 20,856. BRECH MECHANISM OF GUNS, W. A. Burds, London.
- 20,857. GIRTH BELTS, O. C. J. Kratz, London.
- 20,858. SCREW PROPELLERS, E. Edwards.—(F. O. Neuhäuser, Austria.)
- 20,859. MANUFACTURE OF COLOURING MATTERS, H. H. Lake.—(Vidal Fixed Aniline Dyes, Ltd., and L. Haas, France)
- 20,860. INTERMEDIATE SAFETY TUBE, J. H. Page, London.
- 20,861. MANUFACTURE OF ORNAMENTAL ARTICLES, R. Elsdon, Birmingham.
- 20,862. MEASURING ELECTRIC CURRENTS, G. L. Addenbrooke, London.
- 20,863. RAILWAY CAR COUPLINGS, W. Silver, London.
- 20,864. PNEUMATIC TIRES, H. B. Vinton, London.
- 20,865. GROOVES IN STAIR STRINGS, W. Osment, London.
- 20,866. STEAM BOILERS, W. P. Thompson.—(P. A. Henningsen, Germany.)
- 20,867. SUBMARINE BOATS, C. H. Homan, London.
- 20,868. INDICATING NAMES OF STATIONS, R. Eürk, Liverpool.
- 20,869. WIRE-DRAWING MACHINES, W. J. Glover, Liverpool.
- 20,870. PLANT LABELS and PENCILS therefor, J. Backhouse, Liverpool.
- 20,871. RETAINING GARMENT POCKETS IN SHAFF, S. H. Roberts, Liverpool.
- 20,872. FLEXIBLE SPINDLES, F. King and W. Moore, Manchester.
- 20,873. METHOD OF DRYING PEAT, E. Springborn, London.
- 20,874. CORD FASTENERS, G. E. Heafield, London.
- 20,875. MACHINE FOR CUTTING THISTLES, W. Sutherland, Edinburgh.
- 20,876. COLOURING-MATTER MANUFACTURE, H. H. Lake.—(Vidal Fixed Aniline Dyes, Limited, and L. Haas, France)
- 20,877. REFLECTING LAMP SURFACES, The Improved Electric Glow Lamp Company, Ltd., and A. Barnes, London.
- 20,878. DRIVING GEAR FOR CYCLES, P. H. Syngé, London.
- 20,879. STEAM ENGINES OF VESSELS, &c., J. Weir, London.

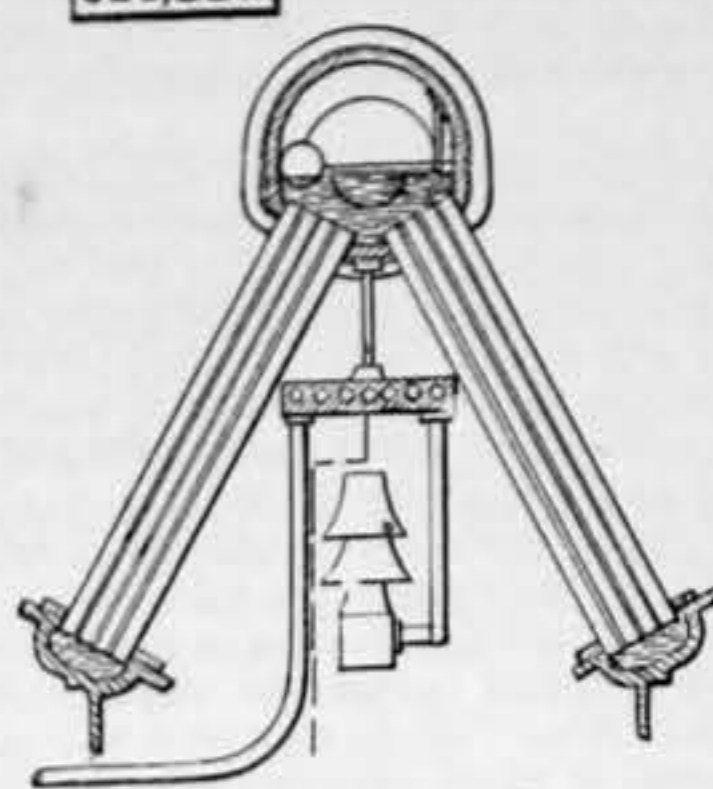
- 20,880. TABLES, J. L. B. Templer, London
- 20,881. ELASTIC TIRES OF VEHICLE WHEELS, G. Meyer, London.
- 20,882. SLIDING CONTACT FOR TELESCOPIC or similar ADJUSTABLE ELECTROLIERS, M. Weidlich and K. Nies, London.
- 20,883. LOCKS, H. von der Höb, jun., London.
- 20,884. AUTOMATIC GAS IGNITERS, F. Trendel, London.
- 20,885. AUTOMATIC COUPLING APPARATUS, G. Rolli, London.

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- 20,886. FURNITURE POLISH, L. Masteyman, Northwood, Middlesex.
- 20,887. BOOT-FINISHING MACHINES, H. A. Oldershaw, Leicester.
- 20,888. BOTTLE STOPPERS, G. McEachron and E. J. Rabideau, Kingston-on-Thames.
- 20,889. MECHANICAL TOY, C. J. Parry, Leyton, Essex.
- 20,890. CIGARS, L. Aviss and Aviss Bros., Limited, Coventry.
- 20,891. BRAKES, W. E. Turner, Coventry.
- 20,892. SPINNING MULES, H. Wrigley, Rochdale.
- 20,893. NECKTIE RETAINERS, J. Allday, Birmingham.
- 20,894. GOLF CLUBS, J. Hunter and P. S. Grant, Glasgow.
- 20,895. DRAWING BOARD HOLDER, F. W. Proctor, Macclesfield.
- 20,896. SEWING MACHINE SHUTTLES, Bradbury and Co., Ltd., and S. Cooper, Manchester.
- 20,897. HANGING BRACKETS, D. Bridge and C. Tetlow, Manchester.
- 20,898. METHOD OF PRESERVING MILK, J. J. Broadfoot, Glasgow.
- 20,899. REGULATING AIR-COMPRESSING ENGINES, J. Lumb, Elland, Yorks.
- 20,900. BILLIARD-MARKING BOARD, H. M. Salmony, London.
- 20,901. DROP-and-LIFT WINDOW, D. Oldham, Hyde, near Manchester.
- 20,902. COMMUNICATION APPARATUS FOR TRAINS, W. Barker and J. H. Wyke, Buryley.
- 20,903. WORKING RAILWAY POINTS, F. W. Webb and A. M. Thompson, Crewe.
- 20,904. SUSPENSORY ATTACHMENT FOR BELTS, N. Lee, Dundee.
- 20,905. INTERNAL COMBUSTION ENGINES, G. Hirt and G. Horn, Halifax.
- 20,906. TROLLEY STANDARDS, E. M. Mudd, W. Wood, H. Brecknell, and H. I. Rogers, Bristol.
- 20,907. METHOD OF STEEPING FLAX, A. Badoil, London.
- 20,908. CHECK COUNTERFOIL, T. Chell, jun., Liverpool.
- 20,909. EXTRACTION OF LIGNIN FROM FLAX STALKS, A. Badoil, London.
- 20,910. BAND BRAKES FOR CYCLES, H. L. Lowrie, London.
- 20,911. SMUT EXCLUDER FOR OPEN WINDOWS, E. J. Boys, London.
- 20,912. ELECTRIC TRAMWAYS, W. H. Merriman, Birmingham.
- 20,913. MUDGUARDS, C. W., F. H., and E. A. Bluemel, London.
- 20,914. FASTENING FOR WEARING APPAREL, A. M. Bruerton, London.
- 20,915. CYCLE BRAKES, C. A. Babington, London.
- 20,916. CUSHIONS, E. M. Payn, London.
- 20,917. RAISING WINDOWS, C. Koringer and A. Lagus, London.
- 20,918. AIR EXTRACTORS, F. H. Wardle, London.
- 20,919. WOOD MORTISE CHISEL, W. Osment, London.
- 20,920. NEW SEA-ON-LAND ROUNDABOUTS, E. Bush, London.
- 20,921. STRETCHER JOINTS OF UMBRELLAS, W. A. Bindley, W. J. Gell, and J. F. Boham, London.
- 20,922. SPINNING COTTON, W. A. Phillips, London.
- 20,923. MANIPULATING MASSES OF METAL, C. Davy, London.
- 20,924. HEATING BY GAS, J. H. Dale and W. H. Bushell, London.
- 20,925. OBTAINING CAUSTIC LYES, C. Luckow, jun., London.
- 20,926. ROPES, E. F. W. Köpcke, London.
- 20,927. SLUICE GATES, R. Haddan.—(J. E. Whiting, India.)
- 20,928. MUSICAL INSTRUMENTS, T. O. Underwood, London.
- 20,929. ARTIFICIAL BUILDING STONE, G. de Bruyn, London.
- 20,930. ARTIFICIAL BUILDING STONE, G. de Bruyn, London.
- 20,931. SPINNING COTTON, A. Metcalfe and C. J. Sumner, Manchester.
- 20,932. TRAPS, F. Lamplough, London.
- 20,933. TABLES, T. C. Brown, London.
- 20,934. PRODUCING INDIA-RUBBER, W. J. Cordner, London.
- 20,935. TIRES, F. W. Schroeder and P. W. Moran, London.
- 20,936. PLAIN or DECORATED CERAMIC WARE, A. Metz, London.
- 20,937. SHEET-METAL PULLEYS, C. A. Brisley, London.
- 20,938. TRIMMING OF LADIES' HATS, A. E. Phillimore, Birmingham.
- 20,939. MOULDED BLOCKS OF MASSES OF STEEL, L. Perid, London.
- 20,940. SYPHON WATER-WASTE PREVENTING APPARATUS, R. Chanby and H. C. Milbank, London.
- 20,941. CAPPING ENDS OF CORSET STEELS, A. F. Ray, London.
- 20,942. PRODUCING COLOURING MATTERS, J. Y. Johnson.—(The Badische Anilin and Soda Fabrik, Germany.)
- 20,943. METALLIC HOLLOW-WARE, H. A. Eckstein, London.
- 20,944. WHEELS, H. A. Eckstein, London.
- 20,945. DENTIFRICE, F. P. Klein, London.
- 20,946. ANIMAL WASH, I. S. McDougall, London.
- 20,947. CLEANING SHIPS' BOTTOMS, B. S. Miles, London.
- 20,948. CONVERTING ROAD DUST INTO FUEL, E. Springborn, London.
- 20,949. METAL FITTINGS FOR FARTHERWARE, R. Borsdorf, London.
- 20,950. EXTRACTING VEGETABLE OILS, A. F. Lundeberg, London.
- 20,951. PNEUMATIC TIRES, M. M. Dessau and The Wapshare Tube Company, Limited, London.
- 20,952. PNEUMATIC TIRES, M. M. Dessau and The Wapshare Tube Company, Limited, London.
- 20,953. PNEUMATIC TIRES, M. M. Dessau and The Wapshare Tube Company, Limited, London.
- 20,954. LOCKING THE NUTS OF BOLTS, A. Lége, London.
- 20,955. PURIFYING ALCOHOLIC LIQUIDS, C. W. Ramsay, London.
- 20,956. COMPRESSING AIR, A. J. Boul.—(The Parke and Lacy Company, United States)
- 20,957. INDICATOR FOR TYPEWRITERS, M. J. Myers, Birmingham.
- 20,958. BURNERS FOR OIL LAMPS, J. Sharples, Birmingham.

(2) In a tubular steam boiler, the combination with a steam generator, two series of water-tubes communicating with the generator and inclined downwardly and outwardly therefrom in opposite directions, mud drums with which the lower ends of the tubes communicate, a combined vaporiser and baffle located beneath the generator and intermediate the two

629,882

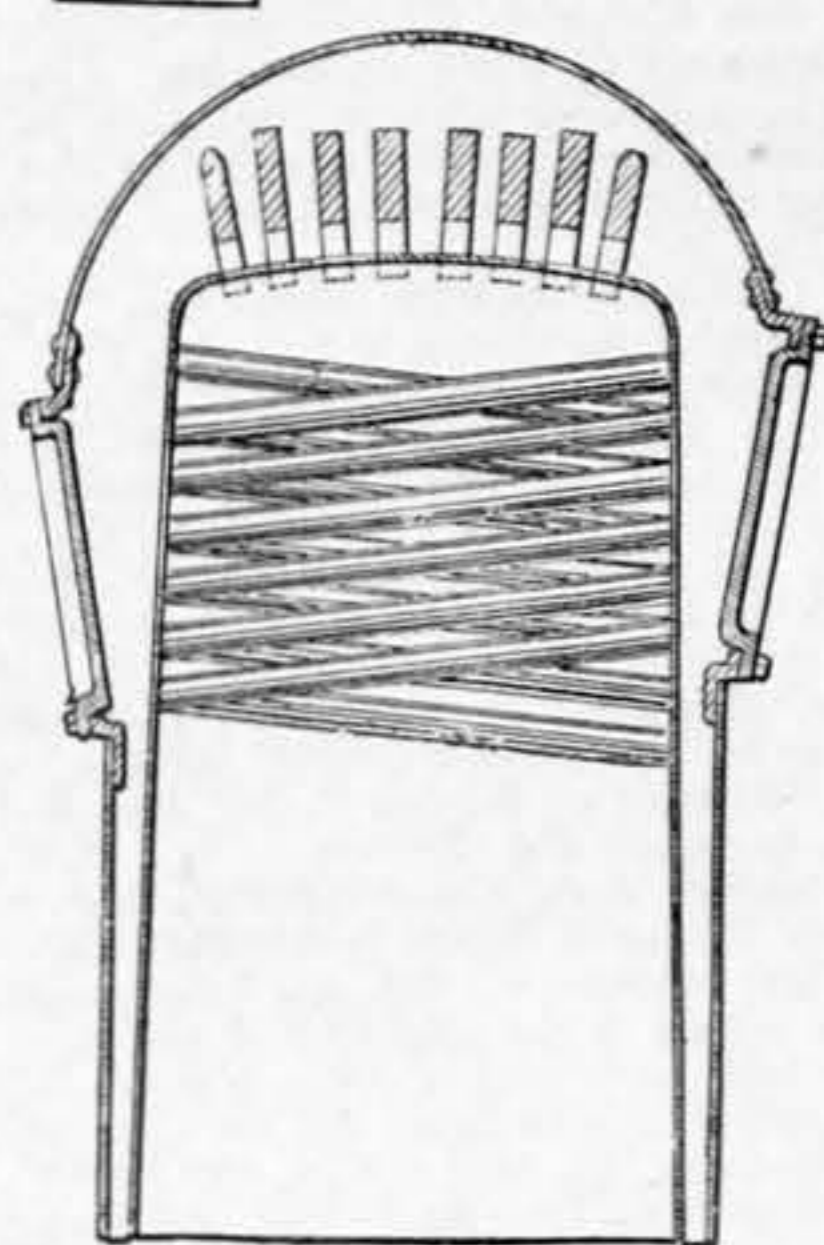


series of water-tubes and a vapour burner beneath and connected to the vaporiser, substantially as described. (3) In a tubular steam boiler, the combination with a generating chamber, of a pivoted float-plate within the chamber and baffle plates carried upon the float-plates, substantially as described.

629,893. LOCOMOTIVE BOILER, D. Drummond, Surbiton, England.—Filed February 16th, 1898.

Claim.—The combination with a boiler having tubes H, and a fire-box having double sides with water spaces between them, of a plurality of sets of inclined water-tubes in the fire-box and between opposite side

629,893

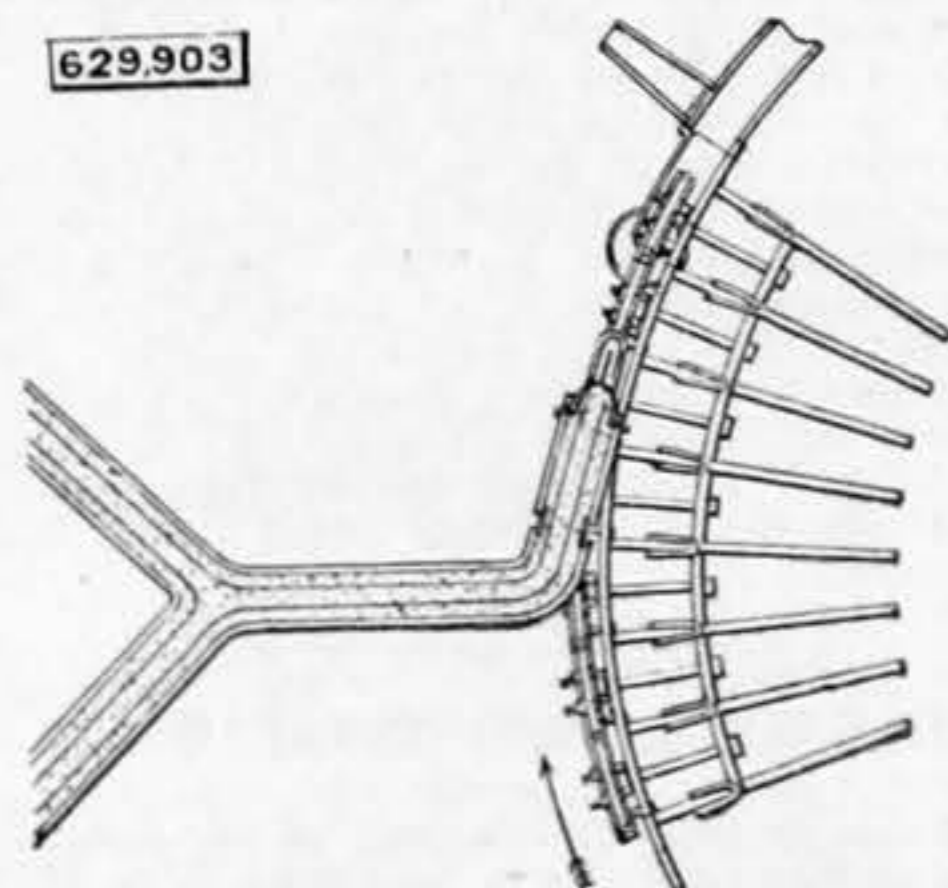


spaces; the first set of tubes being near the door of the fire box and inclining in one direction; the second set being nearer the rear of the fire-box; consisting of a larger number of tubes, said tubes inclining oppositely to those of the first set.

629,903. APPARATUS FOR CASTING PIG METAL, J. M. Hartman, Philadelphia, Pa.—Filed May 24th, 1898.

Claim.—In an apparatus for casting pig metal, a series of moulds made of a single plate of comparatively thin wrought iron or steel; a series of mould-frames, consisting of metallic strips, conforming internally substantially to the shape of the mould

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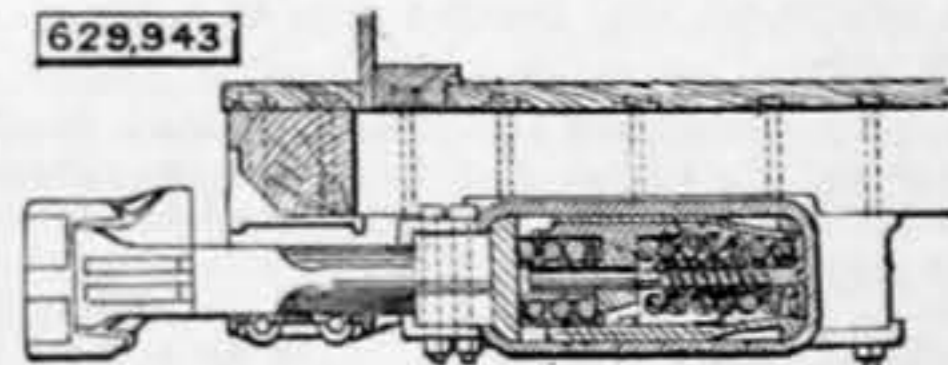


each of which contains one of said moulds detachably secured therein; a spout from which molten metal may be fed; and a traversing device by which said mould-frames with the moulds which they contain are carried in continuous series beneath said spout, substantially as described.

629,943. DRAW GEAR and BUFFING APPARATUS, G. Westinghouse, Pittsburg, Pa.—Filed February 26th, 1898.

Claim.—(1) In a draw gear or buffing apparatus, the combination, substantially as set forth, of intercalated frictional devices, a wedging device for imposing frictional resistance thereon, and means for releasing said wedging device which are adapted to be inert during the exertion of maximum compressive strain, and operative as to releasing action, when, and only when, said maximum strain has been reduced. (2) In a draw gear or buffing apparatus, the combination, substantially as set forth, of a housing carrying a series of outer wedge bars, a wedge block, two or more sets of carrier plates surrounding the wedge

629,943



block and fitting inclines thereon, interlocking members for regulating the disposal of the sets of carrier plates in determined serial relation, a series of inner wedge bars resting on the carrier plates and adapted to bear against the outer wedge bars, tenons on the inner wedge bars adapted to engage with the carrier plates, recesses in the carrier plates adapted to receive the tenons of the inner wedge bars, and of different widths respectively, in the different sets of carrier plates, relatively to the tenons of different units or groups of the inner wedge bars, and a spring abutting on one end of the housing and on the adjacent ends of the carrier plates.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

629,882. WATER-TUBE STEAM GENERATOR, F. Windham, London, England.—Filed February 23rd, 1898. Claim.—(1) In a tubular steam boiler, the combination with a steam generator, two series of water-tubes communicating with the generator and inclined downwardly and outwardly therefrom in opposite directions, mud drums with which the lower ends of the tubes communicate, a vaporiser located beneath the generator and intermediate the two series of water-tubes, and a vapour burner beneath and connected to the vaporiser, substantially as described.