Correspondence.

The Armament of the "Alabama," "Wisconsin," and "Illinois."

To the Editor of the SCIENTIFIC AMERICAN:

This morning's paper contains a summary of the report of Capt. O'Neill, Chief of the Bureau of Ordnance (Navy), from which it would appear that the bureau proposed to abandon the 13-inch gun for the primary battery of our battleships, and substitute a powerful 12-inch, as our cousins across the water have long since done. I note with regret the statement that the new guns will be first supplied to the three ships of the "Ohio" class, and that those of the "Alabama" will be armed with the present type of 13-inch.

While it may be too late to change the armament of the "Kentucky" and "Kearsarge," against which so much may be urged, is it too late to make such changes in that of the "Alabama" class as will make it up to date when those ships are commissioned?

Am I wrong in thinking that the armament now proposed for the "Alabama," "Wisconsin," and "Illinois" is even now behind the times and will be still more so when those vessels are commissioned? If so, I shall be glad if you will kindly set me right, and if I am not, should not an effort be made to secure for those ships a more modern battery?

EDMUND M. PARKER.

Boston, October 19, 1898.

Concerning Steam Boilers.

BY EGBERT P. WATSON.

An industry that comparatively little is known about, in the popular view of the subject, is the making of steam boilers, yet it is one of the largest in the country, if not in the world, employing immense capital and vast numbers of men. The stock of raw material carried by some boiler-making firms is enormous, and a faint idea of it can be had from the fact that one of them recently reboilered three of the monitors in thirty days, without buying a pound of stock outside of that in hand when the work was begun. Another firm, by no means the largest, told the writer that $100,000 would not cover the stock carried by them at all times; and this minor detail, so to call it, shows in some degree the large amount of capital employed all over the country in carrying on the business in question. Add to this the fact that the work is bulky and requires plenty of room to handle it in, that large shops in cities are costly in real estate, and as a corollary increase the interest account, and it is readily seen the business of making steam boilers is one of magnitude.

The writer has no means at hand of ascertaining the amount of money invested in boiler making, in comparison with other industries, but enough has been said to show that the sums are large, and the output is in keeping with it. A case in point is one order for California parties which required fifty freight cars to transport it, and the boilers were all for one plant too; it is by no means a solitary instance. There are countless boiler-making firms in this country, and, as a rule, they are always busy. Hundreds of tons of boilers and hundreds of thousands of horse power are turned out yearly, but so little is known of the vast extent of the trade, that the public generally hear little about it.

Another thing which shows the extent of the boiler-making industry is the demand for steel plates, for all boilers are now made of this material. At this writing it is not possible to get an order for steel plate filled in any sort of reasonable time. There are very few steel mills in the country that are not oversold for weeks ahead—months is the better word; for the principal of a boiler works told the writer a week ago that he had been waiting since July for an order from Pittsburg and had not yet received it. This seems incredible, in view of the number of steel mills in the country, but it is quite within the fact, for upon writing to one of the largest in the country to learn the reason for delays, the above statement was made. Parties have been waiting for months for steam boilers, all summer, in fact, and have not yet got them. This is a serious state of affairs, and is not likely to be improved very soon, in view of the new vessels ordered by the government, which will require large quantities of stock.

Steam boilers are of all classes, but may be broadly grouped into three—marine, stationary, and locomotive. These again may be subdivided into two classes—water-tube and fire-tube. Stationary boilers are by far the most numerous, and these are also fire-tube and water-tube boilers. The latter, although supposed to be modern, are in reality one of the oldest types; a boiler of this class was found in the ruins of Pompeii some years ago, where it had been used for heating water in a bath, and there are boilers in use to-day based broadly upon the same line of construction as this old-timer.

It is only very recently, however, that serious attention has been paid to this type for marine use, and it is gaining ground rapidly. The reasons for this are its lightness, rapidity of action, its ability to carry extremely high pressures safely, and its simplicity of construction, whereby units of great weight and bulk are avoided. The water-tube boiler has no shell, such as the fire-tube boiler has, and its steam drum, or dome, as the case might be, is so small as to be of no moment as regards weight. Few of them are over half an inch thick and from 15 to 18 inches in diameter, while the shells of high pressure marine boilers are from 1¼ to 1½ inches, nearly, in thickness; these shells are also very large in diameter; 16 to 18 feet is not uncommon, so that the total weight of the shell alone is very great. The rivets run from 1 inch diameter to 1½ inches in some parts, while the stay bolts from head to head are 3 to 5 inches in diameter. It will be seen from even this brief citation of sizes that a high pressure marine boiler of the Scotch type is a formidable affair as regards weight alone, and that water-tube boilers are highly desirable, since they weigh two-thirds less for the same rating. The torpedo boat and the high speed yacht would be impossible were it not for water-tube boilers.

MODERN METHODS OF MANUFACTURE.

Not very many years ago boilers were made wholly by hand. That is to say, the sheets were flanged over formers by sledges and mauls and the holes punched by gang punches with more or less accuracy. The sheets were rolled to shape as nearly as possible and sledged home the rest of the way when they failed to meet as closely as was necessary. If the rivet holes did not come fair, a tool called a drift pin was driven in them and the sheets pulled somewhere near to fairness in the rivet holes, then the rivets were closed up as best they could be under the circumstances. This was very bad work certainly, but it was the best that could be done with the crude appliances of the day.

Such work is not now permitted, and no tool or appliance is too costly, if it will expedite the business. Some of the machines in use will take a shell rolled to shape and drill every hole in the circumferential and longitudinal seams, and after the sheets are drilled the sheets are taken down again, and all the burrs left by the drill in going through the plates are dressed off, for, in marine boilers particularly, no punching of holes is permitted. For one thing, it is not possible with the very thick plates; and, for another, the government says that, as far as its work is concerned, we must not punch. In the matter of caulking the seams, men used to do this work by hand, and it was a tedious job. Now a man takes a pneumatic tool and goes over a seam very much as a woman would run up a skirt upon a sewing machine, and almost as quickly. By the old way, gangs of men closed all the rivets by laborious work with hand hammers; but in the new dispensation a grim, determined, hump-backed machine sets all the rivets with one fell stroke, and eats up a seam as fast as men want to handle it. The riveting gang is a thing of the past, except in the few instances on special jobs where the steam riveter cannot get at the spot.

So rapid are the processes of constructing modern boilers, that it is entirely possible to make a so-called 40 horse power return tubular boiler, and ship it on the cars near the shops, inside of eight hours. That is to say, the flat sheets are taken from the floor, bent to radius required, punched (this time because it is quicker), heads put in, riveted as to all seams, set as to all tubes, caulked and tested, and sent off to its destination. The writer's informant, as to this expedition, was a man who worked in the shop where it is done. If it is not quick work, it comes pretty near it.

POWER OF BOILERS.

Regarding the "power" of steam boilers, the word is misapplied, but it is still used by reason of custom, and because there is no other popular term to express a boiler of a given size. It is obvious that a steam boiler is merely a magazine of stored force which may be, and is, of varying power in accordance with the way in which it is used. A reservoir of water could not be said to be of 5,000 or any thousand horse power if its contents were directed on to a turbine wheel, unless it was also stated how long and with what volume and fall the water was used. Similarly, a steam boiler is of varying power for a given rating in grate and heating surface, according as its stored force is used. The rating of steam boilers is now expressed in terms of their ability to evaporate certain quantities of water into dry steam in a given time, and this is the only fair test that can be given. The purchaser then knows exactly what he is getting and can use the steam in one hour or in ten hours. No questions enter into argument as to the amount of heating and grate surface; these things rest with the designer of the boiler and it stands or falls by its performance. These last values, heating and grate surface, have greater or less significance, according to the disposition of them and their relation to each other. A square foot of heating surface on a boiler is of much greater efficiency in one place than in another. To merely state, then, that a boiler has ten square feet of heating surface to a horse power means nothing at all as regards its evaporative effect, and its performance cannot be accurately relied upon.

This will be clearer to non-technical readers when it is stated that a single engine, having a single cylinder, should produce a horse power upon 30 pounds of water evaporated into steam of 70 pounds gage pressure; a compound engine, having two cylinders and working at from 6 to 10 expansions, will produce a horse power for an expenditure of 20 pounds of water; and a triple cylinder engine, working at 16 to 30 expansions, should give one horse power for every 15 pounds of water evaporated into steam per hour, in all of the above citations. Now, the same boiler will supply all of these engines (in rotation) if the proper pressures for the work are carried, but the power developed is vastly greater with the high expansion engines than with the simple engine. Very much higher values could be given for high expansion engines, but the writer has taken the average. It seems plain, therefore, that the power of a boiler begins and ends with its ability to evaporate certain quantities of water in a given time.

Furthermore, the evaporative power of boilers depends largely upon the amount of coal burned upon the grate in a given time, so the power of a boiler of certain dimensions can be augmented over its normal power by using artificial draught of one kind or another, air driven in directly by a fan or air drawn in by induction, as with a jet or with the exhaust turned into the chimney.

Take the case of a locomotive; under the stimulus of the exhaust, a locomotive of say 1,200 square feet of heating surface and 18 square feet of grate surface will develop 600 horse power, but the normal capacity rating of a locomotive boiler under stationary boiler rules would be only 120 horse power. Each pound of coal boils off so much water into steam; with forced draught rather less per pound of coal than with natural draught, but since 75 pounds of coal are burned in the same time (per square foot of grate) that 15 pounds of coal are burned by natural draught, nearly four times the amount of water is boiled into steam in a given time.

The fact that high powers can be obtained from boilers of a given heating surface is well shown by fast yachts and by torpedo boats. A high speed steam yacht built last year has a boiler of only 1,200 square feet of heating surface, but this boiler has been worked up to over 600 horse power with quadruple engines and forced draught of great intensity. As regards this last, the punishment that a boiler will stand without giving up the ghost incontinently is astonishing, and water-tube boilers seem specially adapted to this method of driving them. The writer hesitates to mention all the reports he has heard in this direction, but it is asserted that the forced draught used on the tests of battleships and cruisers is so powerful that it will take the contents of a shovel off it when held to the mouth of a furnace. Forced draught, so called, is commonly used, but it is only a feeble zephyr compared with forced draught when crucial tests are made. Of those who attend boilers at such times, it may truly be said, "the smoke of their torment ascendeth forever," and the flying coal dust, the roar of the fans, and the gases battling together in the furnaces, the stifling heat from the radiation and the temperature of the steam, the mere physical labor of handling so much coal rapidly, all these combined make an inferno rivaling that which Dante described. It is astonishing that men can endure the nervous strain entailed by the work itself and the knowledge that if a tube blows out or bursts under the cruel punishment it is getting, there is but a short shrift for all in the vicinity. The seven labors of Hercules did not include firing a Scotch boiler under an air pressure of six to seven pounds (and no one knows how much more); if they had, he would probably not have come off so well as he did, for many a modern Hercules has been dragged away from the front of the furnace where he had fallen prone under stress of his work. Outside of the boiler it is pretty bad, but what is it inside? Shadrach, Meshach, and Abednego cast into such a fiery furnace would have shriveled into tinder before they reached the bridge wall; it is a white hot hell of glittering intensity, of inconceivable temperature, and no eye but that of an eagle, which can stare the sun out of countenance, can gaze long upon its ferocity. And yet modern steel plates stand this furious work for hours together, and are, apparently, none the worse.

A New Comet.

Dr. William R. Brooks, director of the Smith Observatory, Geneva, N. Y., discovered a new comet on the evening of October 20. Its position was R. A. 14 h. 35 m. 10 s.; declination north 60° 26'. The comet being circumpolar, and hence remaining above the northern horizon all night, Dr. Brooks was able to secure a second observation the same night, just before daylight, through breaks in the clouds. Its position at that time was R. A. 14 h. 46 m. 30 s.: declination north 59° 32'. This shows the motion to be quite rapid in a southeast direction. The comet at the time of discovery was in the constellation Draco.

It is of good size, round, with central condensation, and visible in moderate sized telescopes.

This is the twenty-first comet discovered by Dr. Brooks.