in those positions chiefly for the engineering information they can pick up for the department at home. Of course they are engineers. Nothing of the kind. They are line officers without training for such duties. The country no doubt will be amazed to learn that the education of these line officers, preparing them for the most desirable duty of naval attaché abroad, is accomplished in 10 or 14 days. Previous to taking their departure for Europe to perform the engineering duties required of a naval attaché, they receive a roving commission to visit the largest engineering establishments in this country. The very fact that they undertake to study American methods in 10 or 14 days shows their absolute incompetency for the work. The only advantage they derive from this tour of inspection is that they receive eight cents a mile while making a pleasant excursion at the expense of Uncle Sam.

It was through one of these brilliant attachés that the government spent a large sum for the purchase of plans in England for the *Charleston*. In a discussion before the Engineering Congress at the World's Fair, Mr. Mattice gave some information about these plans that shows how competent was the attaché. The plans were supposed to be those of the *Naniwa-Kan*, but the general plans were those of the *Etna*, and the details were of the *Naniwa-Kan* and *Giovanni Bausan*, "and there were one or two of a rather chestnutty flavor that would not fit in with anything else." The Secretary of the Navy ordered these plans to be followed closely, and as a result costly changes had to be made as the work progressed, and the vacuum pumps had to be discarded and new ones built at a cost to the government of $50,000. Another set of plans purchased in England were not quite so bad, but many changes were made in them by the bureaus of steam engineering and construction before the *Baltimore* was built from them.

THE OPPOSITION OF THE "MACHINE."

The machine fights tooth and nail the proposition to improve the number and status of the engineers, and insists that any increased authority given them will demoralize the service. They charge the engineers with a desire to get everything in their power. As this article is in course of preparation, there comes to our desk a copy of the *Army and Navy Journal* for Oct. 3, containing an article written by a line officer. In this article he says: "The engineer feels that since modern vessels depend entirely upon steam for ability to use their guns, and since engines depend on trained knowledge, and since he must undergo danger without the line officer's privilege of striking back, *he should have the best of everything*. It is suggested that the naval engineer is on a plane with the scientific army engineer, and it is proposed *to make the naval engineer the leading officer of the navy*. They forget that their basis is engine-drivers." The italics are ours. The supposed claims they emphasize are fictitious and false. The engineer does not ask for the command of vessels, but he does believe that the good of the service and his own honor alike demand that he be under the authority of the commanding officer of the vessel and not at the beck and call of every officer of the deck, even an ensign. He does believe that the good of his branch of the service demands that his present "ralative rank," which is title without authority, be changed to a positive rank by which his titles will mean something. He does believe that the deception now practised upon the people of the nation, by which engineer officers appear in civil life and on state occasions with the honors of their titles, but on board ship are stripped of it all, is a farce that endangers discipline and engenders discontent and strife among the entire crew.

But the line officer we have quoted above is really anxious about the engineer. Hear him again: "The engineers want too much, but that is no reason why they should not have justice. *Let us do justice.*" Need we go any further for evidences of a clique? Has it come to this that the line officers announce to this nation that through the line, if at all, justice is to be meted out to the engineers? We admit that proposed changes in the navy affecting the authority of officers might properly originate with the line in which the right of supreme command is vested, but there is little hope that they will. We quote again: "The line is the corps of command, and must be. Nothing the engineers may do can alter that. . . . When the engineers recognize that command is essential and must go to the line, then it will be possible to institute a new plan that will give them justice. If they can once see that *the corps of command is the navy*, a reform can be made that will give them a share of the honors of war. I suspect that the real bitterness of the engineer's fight has lain in the feeling that he belonged to a body of men who are expected to do the dirty work, accept danger in the dark and get none of the credit of success."

The corps of command is *the* navy! This is on a par with the insolence of the line officer who told an engineer that he (the engineer) was *in* the navy but not *of* the navy. The engineers, a body of men who are "expected to do the dirty work, accept danger in the dark and get none of the credit of success"? Who expects them to do this? The line officers may, but does the nation? The real bitterness of the engineers' fight has lain in the fact that he knew the nation thought he was getting his due credit, whereas it was being systematically withheld from him. But the last quotation relieves us of the necessity of proving that engineers are unjustly treated under the present order of things, for this line officer expressly admits that they are.

HOW A NAVAL RESERVE CAN BE OBTAINED.

Then both justice and the immediate needs of the service make it imperative that the engineer corps be increased in numbers and that the engineers be given rank equal to their confreres in the line and an authority that will make that rank respected. But another and an equally good reason exists for raising the status of the engineer. If the number of engineers is to be increased and an adequate reserve is ever to be provided for the time of war, inducements must be offered to get men for the service. They will not enter it in sufficient numbers under the present conditions. The engineers already in the navy would resign from it with little delay, did not loyalty to their country and the hope of finally receiving justice from her hand keep them in her service. Even as it is resignations have been numerous, and the number of engineers graduating annually from the naval academy is not sufficient to balance the loss from breakdowns, deaths and other causes. If honorable positions in the navy are with in the reach of graduates of our technical schools and colleges, many will avail themselves of the opportunity—but not until the engineer is accorded justice. And if war should ever come, ex-naval engineers and others in private life will not offer their services to their country—where such services involve a degradation. It may be argued that loyalty should bring the engineers into their country's service in time of dire need, regardless of questions of rank and title. It should not be forgotten, however, that the greatest of patriots are always the manliest of men, and that a nation which wants the services of noble men in time of war should not neglect the present opportunity to make that service an honorable one.

The engineering profession of the United States have pointed out the naval weakness to Congress and the people, but they have done more than that—they have shown what remedies should be applied. The Wilson-Squire bill, already mentioned, introduced in the House by the Hon. Francis H. Wilson, of Brooklyn, N. Y., should be the basis for all naval legislation enacted for the personnel. If the engineering profession will continue to display its interest in this bill, Congress can be made to realize the crippled condition of the navy, and the bill thus become a law.

TESTING CAST-IRON CAR WHEELS.

In one of the earlier articles on the Altoona shops, which appeared in these pages, an account was given of a method of testing car wheels by pouring molten cast-iron around the treads, the wheels being laid in the mold with their backs or flanges down. As was then described, a sand mold is made around the tread of the wheel which leaves a space of about 2 inches wide between the sand and the tread. Melted iron is then poured into this space. Most of the wheels that have been tested in this way, it was found, broke or cracked in from 25 seconds to 1¼ minutes from the time the metal was poured. The inference from this was that if wheels are broken by heating them in this

way they will also be broken by the heating action of brake-shoes when these are applied, especially at high speeds.

It may be said here, incidentally, that mankind may be roughly divided into two classes, one composed of people disposed to entertain new ideas, and the other of those who are not, many of whom have a positive disinclination to give consideration to any subject, or credence to any facts, or accept any process of reasoning, of a kind with which they are not familiar. Many such people, too, are born objectors, and are possessed of a wonderful capacity for finding reasons why things are not so. They are like the lawyer who was consulted in that well-known case of the prisoner who was incarcerated for a certain offense, and who was told by his legal adviser that a person could not be put in jail for the act of which the prisoner had been guilty. "But I am locked up," the client pleaded, but that fact would not change the opinion of the lawyer.

With the class of people referred to facts have no more weight than the lawyer was willing to assign to the curtailment of his client's liberty. It is in vain, in arguing with such people, to bring incontrovertible evidence to establish certain facts. They are deficient in the capacity of believing, which the Scriptures teach is a means of salvation and assure us that neither would such people believe although one rose from the dead.

This digression was suggested by the way in which the account of the thermal tests of wheels at Altoona, which was published in these pages some months ago, was received by some of the readers of the AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL. One correspondent said the test was "sensational." Others said it was not new and some of the wheel-makers thought it was not fair. All admitted that car-wheels are often heated by the application of brakes, but then they say they do not get "so very hot," or they are not heated so quickly by the brakeshoes as they are by the melted iron poured around them. Now as a matter of fact no one knows with any degree of certainity how hot a wheel gets when brakes are applied on a car. One case is reported of a wheel, broken in service, which was so hot an hour after the accident that it could not be touched without burning the toucher. Imagination only can infer how hot it was when broken. As a matter of fact wheels are not "very hot" when they break under a thermal test. They often crack within 25 seconds or less time after the pouring of the metal. Not a very high degree of heat can be transferred to a wheel in that time. Who knows how quickly or to what degree a wheel will be heated if an "emergency" application of the brakes is made when running at the rate of 60 or 70 miles per hour?

Another resource of the doubters is that any innovation in their experience or practice is not new. Even if it is not, the *utility* of it is not affected thereby. Would a reasonable human being object to using any useful information, even if it was exhumed from the catacombs, or dug up from the foundations of the pyramids, and was as old as Egyptian civilization. Wisdom and knowledge don't deteriorate by age if they are really either wise or true.

Some of our readers who are inclined to *dubiosity*—if there is such a word—say that the thermal test is not a practically fair one, and is calculated to unduly alarm the traveling public. Nevertheless, the Pennsylvania Railroad officials at Altoona have been developing the test, and have reached the conclusion that in specifications for wheels which they buy that a certain number in each lot received shall be subjected to a test of this kind, and if they do not stand it all are to be condemned. An extensive series of investigations were made before this conclusion was reached. More than 200 wheels were tested, of which a large proportion—about nine-tenths—were broken or cracked. The fractures were very curious. In a large number they occurred just inside of the rim and extended circumferentially for a distance varying from a fifth to a third of the way around. In some cases the wheel was merely cracked, the fracture not extending through the rim, but in others the rim was broken radially to the circumferential crack, and a piece was entirely detached from the body of the wheel. In others the break would be on a line approximating to a chord drawn to the periphery of the rim or tread. Another form of break was on a circumferential line, about half way between the hub and rim, or where the double plates join the single one outside of them. (Nearly all the wheels tested were of the Washburn, so called, double plate pattern.) These cracks also extended from a fifth to a third of the way around, and were sometimes confined to a circumferential line and in others would extend radially from one or both ends out to or through the rim. In some instances these fractures were mere cracks, while in others a piece was bodily detached from the wheel. Often the break occurred before the molten iron had solidified, and with such violence that it was scattered out of the mold in a way that was dangerous to the bystanders. Another curious phenomenon was the fact that often a secondary fraction would occur after the first one and on the opposite side of the wheel. The two would not always occur at the same part of the wheel section nor in the same form. Some or all of the brackets or ribs were broken in nearly or quite all the tests even when the plates were not fractured. Mr. McLean, the superintendent of the foundry, who made these tests, obtained five double-plate wheels of the old pattern made by the Lobdell Company in Wilmington, Del. What is called the Washburn double-plate wheel, which is the pattern now in general use, has not in reality double plates, as the two plates extend only about half way from the hub toward the rim, and there they unite in one plate which extends to the rim. The Lobdell however, has two full plates, which extend all the way from the hub to the rim with a space of from about 4 to 6 inches in width between them. The plates are slightly curved. None of these wheels broke into pieces; several of the outside plates developed short circumferential cracks, which did not destroy the integrity or the wholeness of the wheel, and it was only the outside plate which was fractured. Altogether they stood better than any other form that was subjected to the test. It would be curious if it should be found advisable to revert to this old pattern of wheel, which was abandoned twenty-five years ago or more—or to something similar to it. This form is to be subjected to a thorough series of tests to ascertain what its real merits are.

Another fact which was ascertained was that wheels which had been in service, or second-hand wheels, did not stand the test as well as new ones. This is contrary to Mr. Outerbridge's theory that cast iron grows stronger if subjected to frequent concussions. Of course it may be that the endurance of these double-plate wheels was due to the quality of the metal in them. It is intended in the investigation which will be made to ascertain how they will act if made of the same material as the wheels which fail. Altogether the Altoona wheels have stood the tests better than any others, excepting the double-plate Lobdell pattern. Some of the Altoona wheels were broken, but many of them stood the test without fracture. It is proposed hereafter to take three wheels from every hundred, and subject one to a drop test and two to a thermal test by making a mould 1½ inches wide around the tread and then pouring iron into it, these wheels to stand two minutes without breaking. The time and the space may possibly be modified if experience shows that it is essential. The adoption of these requirements is quite certain to lead to efforts on the part of wheel-makers to devise forms which will resist thermal strains more successfully than the so-called double-plate Washburn pattern will or does. It may be added that although nearly all the wheels tested were of that pattern, their forms, and especially that of the sets or brackets, varied considerably. The forms of this pattern of wheel which were tested seemed to have little influence in their capacity to resist the expansion of their treads by heat. As was pointed out in these pages before, the strain required to fracture a wheel, even if made of poor material, must be enormous. The area of the fractured section was often as much as 25 square inches. The force required to pull this asunder can readily be calculated. The new requirement of the Pennsylvania Railroad is likely to mark a new era in the manufacture of cast-iron wheels and must lead the makers either to use better material in them or devise new forms which will resist the new test, even if made of inferior iron.