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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TRYING TO PUT A QUART INTO A PINT CUP.

The contention between the House and the Senate on the question of the size of the new battleships has been compromised in a manner which reflects great credit on the generosity of Congress and proves that it is fully alive to the necessity for a large increase in our naval power. The House wished to provide for three battleships of 16,000 tons displacement; the Senate was in favor of four battleships of 12,000 tons displacement. The compromise arrived at provides for three 16,000-ton ships and two 13,000-ton ships. The larger vessels will be of the same class as the "Connecticut" and "Louisiana," and the 13,000-ton ships will class very well with the "Maine" type, thus giving the navy two fleets of five vessels of each type.

In the recent controversy we see the recrudescence of an old fallacy, which has always caused, and always will, more or less trouble in the matter of battleship design; and of battleship design in general it may be truly said that there are no problems in the whole field of technical knowledge in which the layman can more quickly fall into error, than in those affecting the relative efficiency of warships. The trouble with the advocate of the small ship is that he seems to have an idea that it is possible to put a quart of liquid in a pint cup—that a given total tonnage may be divided into a number of numerous small units, each of which would represent individually as much fighting efficiency as would be secured if that same total tonnage were divided into a fewer number of units of much greater displacement.

Now, as a matter of fact, nothing could be farther from the truth. It is as well understood in the navy, as it is in the merchant marine, that the larger the ship the greater the efficiency per ton of ship. Why is it that merchant vessels are climbing up in size so rapidly that to-day they have reached the enormous displacement of 37,000 tons, as represented by the "Cedric" and "Celtic"? It is for the very good reason that each ton in the big vessel has a greater earning capacity than each ton in a smaller vessel; and the situation is strictly the same in the case of ships of war. Each ton of the 16,000 tons of the "Connecticut" represents vastly more fighting power than each ton of a 12,000-ton "Alabama;" and just here, by way of parenthesis, we may add that the theory of building many small ships with a view to covering our coast line is false, for the reason that in future wars battleships will never be scattered in isolated positions for the purpose of doing police duty. They will be gathered into fleets, and the fortunes of war will depend entirely upon the fortunes of these fleets. This is clearly shown in the series of war games which we are publishing week by week in the SCIENTIFIC AMERICAN SUPPLEMENT.

All the navies of the world are steadily increasing the size of their battleships at each appropriation. Great Britain, indeed, whose very existence depends upon keeping her navy in a state of the highest efficiency, is this year providing for the construction of three great vessels of 18,000 tons displacement, or 2,000 tons more than that of the large vessels we have just authorized. This in itself is a most potent argument, when we consider the vast interests at stake, against a return on our part to small battleships of the second-class size. Having said this much, perhaps the best way to consider the subject is to present the arguments in favor of the big ship categorically and as briefly as possible.

1. In the large ship there is a gain in effective battery power. The weight of one round from the 12,000-ton "Alabama" is 5,312 pounds, and from the 16,000-ton "Connecticut" 7,856 pounds. Hence, for an increase of one-third in size, there is a gain of about one-half in effective battery power, or $30,000,000 will give us four "Connecticuts" of a battery power of 6, or five "Alabamas" of a relative battery power of 5.

2. The armor protection of the "Maine" is 2,770 tons, of the "Connecticut," 4,000 tons; an increase of protection of 44 per cent, for an increase in size of 33 per cent. This great gain in power of attack and defense is due to the fact that the big ship requires a smaller proportion of her weight to be given to hull and machinery than does the smaller one for the same power and speed; for, whereas in a 12,000-ton ship 4 tons of any 10 tons of weight must be devoted to the structure, leaving 6 tons for speed, battery, and armor, in 16,000-ton ships similar to the 12,000-ton, only 3¾ instead of 4 tons out of every 10 must be devoted to the structure, so that the weight available for the fighting elements of the vessel is not actually, but relatively, greater for the big ship.

3. In a comparison of the 10,288-ton "Oregon" and the 16,000-ton "Connecticut," we find that the contract speed has risen from 15 knots to 18 knots, and in heavy weather the difference will be yet greater, since the big vessel will maintain her speed, and cast loose her guns for action, in weather that would cause the "Oregon," with her low freeboard, to heave to.

4. Then, again, contrary to popular belief, the big "Connecticut" will be a much more handy ship than the "Indiana." Improved steering gear, and improvements in modeling, will render the "Connecticut" a more mobile vessel, with probably a smaller turning circle, than the "Indiana"—she would require no more, if as much, room in which to maneuver than the smaller vessels.

5. The "Connecticut" carries 2,200 tons of coal; the "Oregon" 1,600, and the radius of action of the larger ship is somewhat greater. To load up the small "Indiana" from her normal coal supply of 400 tons to her maximum supply will increase her draft by 28 inches, whereas the big "Connecticut" in taking on the extra 1,300 tons above her normal supply of 900 tons of coal will only be sent down 20 inches deeper; but most serious of all, at full-load displacement, the "Indiana" will sink her waterline belt armor entirely under water, while the belt of the "Connecticut" would remain where it always should be, partly above and partly below the waterline.

6. As regards fighting powers, the "Connecticut" carries 70 per cent more weight of guns and 90 per cent more weight of ammunition than the "Oregon;" and when we take account of the energy and rapidity of fire of the guns, we find that if all the guns on the battleships were engaged at full capacity for a period of five minutes, the total energy of the "Connecticut" would be 3½ times the greater.

7. In a comparison of defensive qualities, we find that the "Connecticut" carries 4,000 tons of armor against 2,900 tons carried on the "Oregon;" moreover, this greater weight of armor covers a relatively larger area. The belt extends, in the big ships, entirely from stem to stern, whereas in the "Oregon" it only extends over the middle two-thirds of the ship, while there is a total armored area on the sides of the "Connecticut" of 7,827 square feet as against 2,229 square feet in the "Oregon." Again, owing to the great size of the "Connecticut," the secondary battery of twenty guns can be widely scattered and protected by armor; whereas the effect of the smaller size of the "Oregon" on her secondary battery of twenty 6-pounders is that they are packed cheek-by-jowl and without protection, within the limited area of the superstructure amidships. A single high explosive shell properly placed would probably wipe out the whole lot!

8. On the vital question of habitability and comfort for the officers and crew, everything favors the big ship. The men can be housed well above the water line in larger quarters, and the effect of this on the *morale* of the ship's company is beyond estimate.

9. Lastly (and to our thinking, in the test of savage war, it may well prove to be more important than anything else) is the fact that the big vessel is much more difficult to sink than the small one. Should the 10,000-ton "Oregon" and the 16,000-ton "Connecticut" be torpedoed in the same spot, at the same time, with the same type and size of torpedo, it would take, broadly speaking, only six-tenths as long for the "Oregon" to sink as it would for the "Connecticut." A wound, mortal to the "Oregon," might not be so to the "Connecticut," for it is likely that the extra subdivision obtained in the large vessel would serve to keep the "Connecticut" afloat, though the other went down. So also the relative destruction of a 12-inch high explosive shell would be less on the bigger vessel, for the reason that a larger proportion of the bulk of the ship would be outside the immediate danger zone. Indeed, the same inverse ratio of 10 to 16 would apply. Then, furthermore, the gun crews being more widely separated, there would be less disablement by the bursting of a single shell. And would not the "Connecticut" have the prestige and moral effect which always goes with great size, if that size is known to be backed up with high efficiency? The "Connecticut" could pass alone without fear of attack over stretches of hostile water, through which an "Oregon" would not dare to venture.

The test is between size and numbers. We have proved that size is best; and since our country is now the wealthiest in the world, and the most generous in its expenditures, why should we not solve the problem at once and reconcile opposing theories, by adopting both, and building at once the biggest ships and, with the exception of Great Britain, the greatest number of them in the world?

ENACTMENT OF THE AMENDMENT OF UNITED STATES PATENT STATUTES.

The patent bill H. R. 17,085 was passed by the United States Senate before the expiration of the session of the Fifty-seventh Congress, and, as the bill has also received the President's approval, the amendments referred to in our last issue are now incorporated in the United States patent law.

The patent bill was prepared by the Commissioner of Patents at the request of the State Department, and it was introduced in the two houses of Congress early in the second session of the Fifty-seventh Congress; but, because of the failure of the patent committee to see the importance of the amendment, the bill was not reported until a short time ago. The amendment of our patent law in accordance with the provisions of the International Convention has cleared the field for American inventors in the foreign countries which are signatories to the International Convention, for they may now claim all the privileges of the Convention, without the fear that the courts may hold that they are not entitled to them, because of the failure of the United States to reciprocate. The United States is now extending to foreigners all the rights to which they are entitled under the treaty. The benefits of the amendments to the patent laws here and abroad, which have been made in accordance with the amended rules of the International Convention, will be claimed by many inventors who, under the old treaty and laws, were unable to file their foreign patent applications within the short time prescribed by the old regulations.

OUR AGRICULTURAL COLLEGES.

As the result of National and State co-operation, which enables the ordinary farmer to profit from the experiments of widely separated individuals interested in scientific farming, the United States stands foremost in the matter of agricultural development. Our Department of Agriculture renders the greatest service imaginable to the country; but its facilities are greatly improved by the co-operation of the different State agricultural institutions, while the farmers of each section can rely upon their special State colleges to supplement the general work of the National institution. These State agricultural colleges are quietly doing a great good in the cause of scientific agriculture and horticulture.

The Massachusetts Agricultural College is one of the foremost representatives of the typical institution devoted to practical agricultural education, and its work and studies are devoted chiefly to the training of students in modern scientific farming. The work is conducted both in the classroom and on an experimental farm. The institution is located on a farm of 400 acres at Amherst, Mass., and its buildings and land are valued at $315,000. Its annual income from the State and United States amounts to $45,000, and it is provided with a permanent endowment fund of over $350,000. There are buildings for nearly every imaginable specialty pertaining to agriculture—a chemical laboratory, botanical laboratory, plant house, creamery and dairy laboratory, veterinary buildings, barns, museum, library, and entomological laboratory and insectary.

Instruction is given by a corps of eighteen professors and assistants in chemistry, botany, agriculture, horticulture, zoology, veterinary science, mathematics, civil engineering, and similar studies. Practical work on the farm is a part of the course, and the students cultivate the whole farm and experimental orchard and nursery. There are 100 acres devoted to orchards, vineyards, and the cultivation of small fruits. One hundred and fifty acres are under cultivation with field crops, and nearly as many more acres are devoted to grass and hay for the 100 head of cattle which are kept on the farm. Considerably over a thousand men have passed through the Massachusetts Agricultural College. It is interesting to note the locations and occupations of these men. A recent census of them showed that nearly 400 are to-day engaged in agricultural pursuits, more than a score are instructors in other similar institutions, many are dead, and others have drifted into a variety of callings. The effect of the college on the agriculture of the country must prove of immeasurable value if a similar proportion of its graduates adopt farming for their life's work, performing their labors in a scientific manner such as they were taught to do at the institution.

The State agricultural and mechanical colleges which have sprung up in most of the leading agricultural States of the East and West, and many parts of the South, in recent years, have in view the training of young men for scientific and practical agriculture, and also for mechanical and manufacturing arts and sciences. They are endowed by the State in which