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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.

THE BUDAPEST AND MANHATTAN SUSPENSION BRIDGES.

The publication in this issue of an illustrated article descriptive of the handsome chain-cable bridge across the Danube at Budapest, Hungary, possesses timely interest for two reasons: First, that this bridge represents the advanced ideas of the leading bridge builders of the world on suspension-bridge construction; and secondly, that it embodies a type of cable and a form of tower similar to those which were adopted by the bridge commissioner under the late administration for the Manhattan Bridge across the East River, the designs for which were unceremoniously rejected by his successor immediately upon taking office. The Manhattan chain-cable bridge, however, marked a distinct advance upon the Budapest bridge, in the fact that instead of providing a separate suspended stiffening truss, the chain cables themselves were stiffened by means of trusses of which the cables formed the upper chord. This arrangement had the advantages of securing a decided economy of material, a great increase in the stiffness, and a large reduction in the total cost. Although the Manhattan bridge was designed by a noted authority on long-span suspension bridges, it was thought advisable that all doubt as to the merit of the system should be removed by submitting the plans to a board of experts composed of some of the most eminent bridge engineers in this country. The board gave its unanimous approval to the plans and thereby settled once and forever, one would have thought, the question of their feasibility.

It is a matter of history that, in the face of this endorsement, the present bridge commissioner threw out the accepted plans, and substituted for them a type of bridge which is not only distinctly behind the advanced theory and practice of long-span suspension bridges, but is well known to take longer to construct and to be decidedly more costly. Of course the bridge commissioner is entitled to his individual opinion; he is entitled to credit for sincerity in his opinion; but the people of New York city would have more respect for both, if he had not maintained such profound secrecy regarding the plans for the new bridge that even at the present writing, after the bids have been turned in, it is impossible to secure access to the strain sheets for the purpose of making intelligent comparison as to weights and costs between this bridge and the one it supersedes.

Time and again the request has been made that in order to protect the interests of the city, the new plans, like the old plans, should be submitted to an independent board of experts. Failing this, it was suggested that the least that could be done was to present both sets of plans to the contractors, and secure bids upon each. If this had been done, it is confidently believed by bridge engineers in general, that the chain-cable design would have secured bids that were far below those that have been turned in for the wire-cable type. We had fully expected to be able by this time to present a comparative table of weights of material, and of costs for the two designs based upon the strain sheets. But the most extraordinary and unprecedented course followed by the bridge commissioner in not making public, even for expert investigation, the strain sheets of his wire-cable bridge, renders any such comparison quite impossible.

The fact that the city is getting an inferior bridge may be seen, however, even from a cursory comparison, based on only one or two features. Thus, in the original design the towers were designed, like those at Budapest, to rock upon pin footings at the piers—a feature that was favorably commented upon by the board of experts. In the new design the pins have been abolished, and square footings substituted. This was a distinctly retrograde step in itself; but the mischief is aggravated, when we find that the cables are to be rigidly fixed to the top of the towers; for this renders it certain that the pull of the cables will result in uneven and uncertain distribution of pressures on

the piers, and this in turn will tend to produce uneven settlement. Furthermore, although the towers are to be 27 feet less in height, they will weigh no less than 4,100 tons more.

Comment on such facts is superfluous.

Again, in the rejected design the massive floorbeams, 120 feet in length, were hinged at two points to allow for unequal deflection of the two pairs of cables, and prevent injurious bending stresses in these floorbeams. These hinges are an absolute necessity, for the bridge really consists of two bridges, side by side, and at different hours of the day one side may be loaded more heavily than the other and will be depressed accordingly. As a matter of fact, observation has shown that the outside cable on one side of the Brooklyn Bridge when it is under heavier load is sometimes depressed three feet below the other. The same causes will produce the same effects in the Manhattan Bridge; and the provision of lateral flexibility in the floor system is a necessity recognized by all competent engineers. Yet in the present design the floorbeams are rigid and continuous from end to end. This means that destructive stresses, that have not been in any way provided for, will be set up, the life of the floor system shortened, and the repair bill increased proportionately.

The two cases above mentioned are sufficient to indicate that the new design is distinctly inferior to the earlier plans. It will prove to be some \$2,000,000 more costly; and the city will be fortunate if it can make use in 1910 of this greatly needed structure, which, but for the manipulations of a few politicians, would have been opened in the year 1907.

NAVAL LOSSES OF THE RUSSO-JAPANESE WAR.

In the magnitude of the losses incurred history does not furnish a parallel to the great naval conflict, which has been brought to a close by the recent negotiations in this country. From time to time during the past eighteen months, we have portrayed and recorded the principal events of the struggle; and it becomes a matter of interest at the close to sum up the injuries mutually inflicted by the two combatants. At the very outset of our comparison, the matter may be summarized by stating that the whole available fighting forces of one country have been wiped out, while the fighting strength of the other has been, strange to say, greatly augmented, so that the victor comes out of the struggle decidedly stronger in ships and general war material than he was at the firing of the first gun.

In the first place, it must be recognized that both combatants concentrated at the scene of hostilities every available ship in their respective navies. For Japan, this meant every ship that she possessed; for Russia, it meant every ship that was capable of being put into commission, or that already was in commission, with the important exception of the Black Sea fleet which, by treaty, was prevented from leaving the Black Sea. Of the sixteen battleships which, first and last, Russia was able to assemble in the Far East, thirteen, of the united displacement of 153,416 tons, were sunk; two were captured by the Japanese; and one was interned, the total losses in battleships amounting to sixteen vessels, of a united displacement of 189,682 tons. Japan, on the other hand, out of six battleships lost two, of the united displacement of 27,700 tons, both of these vessels being sunk by mines. Of armored cruisers, Russia lost five, of 33,630 tons aggregate displacement. Japan lost no vessels of this type. Of protected cruisers, six Russian ships of 29,730 tons aggregate displacement were sunk, and five of 29,210 tons total displacement were interned, or eleven vessels of 58,940 tons displacement. Japan lost four protected cruisers of 12,750 tons total displacement. In coast-defense vessels Russia lost one by its being sunk in battle, and two were captured by the Japanese, representing a total loss of three vessels of this class, of 12,378 tons total displacement. One Japanese coast-defense vessel of 3,717 tons displacement was sunk during the war.

In the above enumeration we have taken account only of the more important classes of warships. There have been other losses in torpedo boats, converted cruisers, supply ships, etc., which have occurred mainly on the Russian side. The total losses in the more important ships amount, on the Russian side, to thirty-five vessels, of a total displacement of 299,630 tons; while the loss on the Japanese side amounts to seven vessels, of 44,167 tons displacement.

Now that it is agreed that the Russian ships which fled for refuge to neutral ports, and were interned, are to belong to Russia, it is possible to make a rough estimate of the present relative standing of the two navies. If, for convenience, we suppose that the interned ships could be placed at once in commission, Russia's available navy to-day in the Far East (and as we have seen, this is practically the whole of her available navy) would amount to one battleship, the "Czarevitch," now interned at Kiauchau; two armored cruisers, the "Gromobi" and "Rossia," now at Vladivostock; and six protected cruisers, one of which is at Vladivostock, the others being interned at various neutral ports.

Japan, on the other hand, has not only made good the loss of the two battleships by the capture of two of the Russian battleships; but according to reports which have come, apparently under official sanction, from the Far East, she has raised four battleships, one armored cruiser, and one protected cruiser, that were sunk at Port Arthur, and also the protected cruiser "Variag," which was sunk at Chemulpho. This will give Japan a total of ten battleships, nine armored cruisers, and about a dozen protected cruisers, which means that she has a much more powerful navy to-day than she had when the first blow was struck some eighteen months ago.

It is one of the inexplicable facts of the war that the Russians should have left four battleships, an armored cruiser, and a protected cruiser at Port Arthur in such a condition that the Japanese have been able to raise them and take at least two of them to Japan. Naval officers are asking why the Russians, when they set sail from Port Arthur on August 10, did not do so with the determination either to sink some of the enemy or be themselves sunk in the attempt. Failing this, they should at least, in sinking their own ships just before the final surrender at Port Arthur, have wrecked them so completely as to render their subsequent salvage by the Japanese impossible. As it is, the Japanese are likely to put four of these very battleships in commission under their own flag—a feat which must certainly be reckoned as one of the most brilliant of the many brilliant things done by this remarkable people.

PEACE IN THE FAR EAST.

The late Russo-Japanese war has been a war of surprises. The Japanese in particular have astonished the world by the unbroken succession of victories that has crowned their efforts. But nothing that they have done has been so truly dramatic as the sudden display of magnanimity with which, in the full flush of their victories, they suddenly, in the interests of peace, withdrew their demands for the legitimate fruits of conquest, and met the uncompromising stand taken by their beaten foe. Peace hath its victories no less than war; and in consenting to forego the \$600,000,000 indemnity, which by every precedent she was entitled to demand, Japan has won a moral victory which, in its way, is as great as any she has commanded by force of arms. It is an extremely gratifying feature of the successful issue of the negotiations, that the whole world has been quick to recognize this element of magnanimity on the part of the Japanese nation. Not in a single instance has it been suggested that it was fear on the part of Japan that she could not prosecute to its bitter end the war she had begun, that led her to make the concession. Indeed, there can be little doubt that at the crisis of the negotiations, she was within an ace of returning to the arbitrament of war; and it is significant that the whole world is of one accord in attributing the present peace largely to the untiring effort and wonderful tact displayed by President Roosevelt in preventing a final rupture, and in bringing these most delicate negotiations to their present happy conclusion.

It was peculiarly fitting that, outside of the plenipotentiaries, the main instrument in bringing this colossal and bloody struggle to a close should have been the Chief Executive of a nation, one of the first of whose avowed objects is the development of the arts of peace, undisturbed by the burdens and entanglements which rest upon and involve a nation that is professedly warlike. It required no little courage and an infinite amount of tact to approach the belligerents at the very time when the attitude of both of them seemed to be firmly set against receiving the offices of any intermediary. When the first overture was made, not a government the world over believed that it would be acceptable, and up to the very hour of his final success it was predicted, even at the very town where the negotiations were in progress, that his efforts for peace would prove to be completely abortive. It may be said, without fear of contradiction, that this latest act of our President will go down into history as one of the most brilliant and beneficent acts of statesmanship achieved by any President of the United States.

The terms of the treaty, as drawn up in its final form, will prove, all things considered, to be about the best that could be devised, not merely for Japan and Russia, but for all the complicated interests that are involved in the Far Eastern question. Japan has gained all and more than she sought at the commencement of the war. Russia, it is true, has seen her dream of military empire and domination pass absolutely out of sight. But it is quite possible that this loss will ultimately prove to be her gain; for had she continued to follow out that policy, she would ultimately have been involved in a conflict far wider in its scope and more disastrous in its results than that which has just been concluded. Moreover, the generosity of Japan in demanding less than the legitimate fruits of her victories now makes it possible for the contending countries to settle down into mutually amicable relations, each assisting in that future and wonderful develop-

ment of the Far East to which the present peaceful negotiations will prove the threshold.

The attitude of Japan at the opening of the war was shown in the following statement, which she issued to the powers at the outbreak of hostilities: "It being indispensable to the welfare and safety of Japan to maintain the independence and integrity of Korea, and to safeguard her paramount interests therein, the Japanese government finds it impossible to view with indifference any action endangering the position of Korea. Russia, notwithstanding her solemn treaty with China and her repeated assurances to the powers, continues in occupation of Manchuria, and has even taken aggressive measures on Korean territory. Should Manchuria be annexed to Russia, the independence of Korea would naturally be impossible." In the negotiations immediately preceding the war, Russia declined to give any guarantees regarding Manchuria. She also demanded the establishment of a neutral zone in Korea, extending south from the Yalu River; but she declined to establish a similar neutral zone north of the river in Manchuria. It was at this point that the negotiations broke down.

In the terms of peace, as now agreed upon by the plenipotentiaries, it will be seen that Japan secures all, and more than all, that she had asked.

1. Russia recognizes the preponderating interests of Japan in Korea, which will now be under a Japanese protectorate, and will become to all intents and purposes a Japanese colony.

2. Manchuria will be evacuated both by the Russian and Japanese forces, and that great empire will be restored to China.

3. Russia transfers to Japan the leasehold of the Liaotung Peninsula.

4. Russia returns to China its civil administration of Manchuria.

5. The southern and more valuable half of the island of Saghalien is to belong to Japan, and the two countries mutually agree not to erect any military works on that island.

6. Russia transfers to Japan, without compensation, all the docks, magazines and military works at Port Arthur and Dalny.

7. Russia transfers to Japan all of the railroad through Manchuria between Port Arthur and Kunshien, retaining that portion of the line (about one-third) from Kunshien to Harbin.

8. Russia grants to Japan valuable fishing rights along the Siberian coast.

The magnitude of the changes thus brought about in the Far East will be realized by a study of the accompanying map covering the area affected by the negotiations. Russia still retains intact the Transsiberian railroad and the splendid terminal harbor at Vladivostok; she will thus be in a position to utilize these great works for their legitimate purposes of assisting in the development of Siberia by bringing its products to the Eastern Sea. By the acquisition of the southern half of the island of Saghalien, Japan once more acquires land that was originally her own, the loss of which has ever been a sore point with that proud and patriotic people. In Korea she will have ample room for her natural instincts of colonization; and the possession of Dalny and Port Arthur will place her in a strong strategic position to maintain and protect what she has won as the fruits of this costly war.

PEARLS AND PEARL SHELLS.

BY RANDOLPH I. SEARE.

Speaking generally, the substance forming the inner layers of the shells of any nacreous mollusk is termed "pearly." In the mass it constitutes what is known as "mother-of-pearl," while in the form of a detached lustrous concretion it is a "pearl." Dr. W. A. Herdman, of the University of Liverpool, England, in reporting recently on the pearl-oyster fisheries of Ceylon, makes some very interesting statements as to the origin of pearls, from which it appears that some pearls, or pearly excrescences on the interior of the shell, are due to the irritation caused by boring sponges and burrowing worms. It would seem that minute grains of sand and other foreign particles gain access to the body inside the shell, which are popularly supposed to form the nuclei of pearls, only under very exceptional circumstances; in fact, only one pearl out of a large number which Dr. Herdman decalcified, contained in its center what proved to be beyond doubt a grain of sand. It is only when the shell is injured, as by breaking off or crushing the projecting "ears"—thereby enabling some fine sand to work in—that such inorganic particles supply the irritation which gives rise to pearl formation. Another class of pearls, found in the muscular tissue of the animal, are

called "muscle-pearls." They have no organic nuclei, but seem to start as minute calcareous concretions in the tissue. The choicest pearls, to which Dr. Herdman gives the name "cyst" or "orient," occur in the thin muscular margin of the mouth, or in the thick, white, lateral part over the stomach and liver, or at times are found free in a cavity of the body; and Dr. Herdman's observations have caused him to remark that the majority of the fine pearls found in the soft tissues contain more or less recognizable remains of parasitic worms, so that the stimulation which eventually causes the formation of an "orient" pearl, is due to infection by a minute worm which becomes incased and dies; thus, as Dr. Herdman puts it, justifying in a sense Dubois's statement that "the most beautiful pearl in the world is in short nothing more than the brilliant sarcophagus of a worm."

Dr. Kelaart, another prominent authority on pearls, is credited with having been the first to connect their formations with the presence of wormy parasites, although as far back as 1852 Filippi proved that the trematode worm, known as *Distomum duplicatum*, was the cause of pearl formation in some of the fresh-water mussels. Other authorities, such as Humbert, the Swiss naturalist, agree that these worms play an important part in the formation of pearls; and, this being so, it may be asked, What is to prevent the possibility

bank is reached, a signal gun is fired and diving commences. The diver has a stone of granite weighing about forty pounds attached to the cord by which he is let down in order to facilitate his descent. Divers work in pairs, one going down while the other stays on board to watch the signal cord. When this is jerked, the stone is pulled up first, then the basket of oysters, and lastly the man! Divers generally remain below about a minute, and are expected to make forty or fifty descents a day. The pearls are sorted into ten different sizes by passing them through brass sieves containing respectively 20, 30, 50, 80, 100, 200, 400, 600, 800, and 1,000 holes. The number of oysters obtained daily in these fisheries is estimated at about a million. These are auctioned off, and frequently bring \$10 to \$14 a thousand, while even as high a price as \$24 a thousand has been reached. The present local price for selected pearls of one carat and upward is about \$20 per carat. In 1903 the government realized \$271,850, and in 1904, \$351,564 from these fisheries.

Among other localities where pearl fisheries are carried on may be mentioned the Merguian Archipelago under the government of Burma, the lower end of the Red Sea, the Persian Gulf, the waters around the Molucca Islands, in the neighborhood of Zanzibar, and on the west coast of New Caledonia. Nearer home are the fisheries of La Paz, in Lower California, British Honduras, Panama, along the coast of Ecuador and of Peru; and in the lower Gulf of Maracaibo. There is also a flourishing pearl fishery on the northern coast of Australia, where a large fleet of vessels is employed, and another extensive industry has lately been reported in the neighborhood of Thursday Island, north of Queensland.

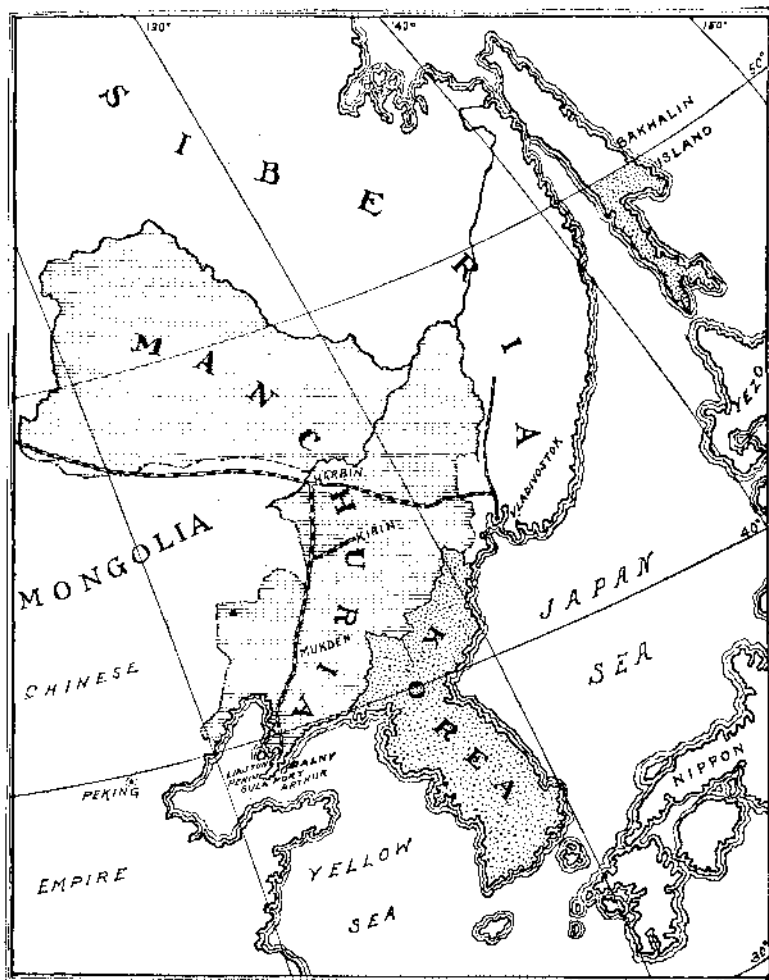
The gathering of pearls from fresh-water shells has been carried on for centuries on this continent. When De Soto was made governor of Cuba, it was agreed that one-fifth of all treasures won in battle, including pearls, should be given to the Spanish crown, and on one occasion his men are said to have obtained three hundred and fifty pounds weight of pearls from Indian graves in Cutifachiqui. The value of pearls from fresh-water shells varies greatly, depending on their size and color. One pearl from a fresh-water mussel was sold for \$1,500, while a round, pink pearl from Tennessee brought \$650. One of the finest pearls ever collected in the United States was the "Queen." It had a beautiful luster and weighed ninety-three grains. It was found near Paterson, New Jersey, in 1857, and was sold to the Empress Eugenie for \$2,500. To-day it is probably worth \$10,000.

Pearl-fishing in the United States has been carried on in many States, including Kentucky, Tennessee, Texas, Wisconsin, Illinois, Arkansas, Missouri, Georgia, and Kansas.

The manufacture of ornamental objects, such as pocket-books, hand-satchels, jewel-cases, etc., from pearl-shells, has during recent years become an important industry, and with their iridescent shades of salmon, purple, pink, and cream, very beautiful articles are made.

The pearl-button industry has increased extensively during the last eight years, and several factories, especially in towns in Iowa and Illinois bordering on the Mississippi River, are now in operation. The principal species of fresh-water mussels whose shells are used in their manufacture is the "niggerhead" (*Quadrula ebena*), while several varieties of "sand shells" are also employed, including the "yellow" (*Lampsilis anodonta*), the "black" (*L. rectus*), and the "slough" (*L. fallaciosus*). One of the best shells is the "deerhorn" (*Tritogonia verrucosa*), and another favorite is the "butterfly" (*Plagiola securis*). The pearl-button industry in the United States began in 1891, the first factory being established at Muscatine, Iowa. The largest factories turn out as many as a thousand gross of finished buttons a day, the average price obtained being thirty-five to forty cents a gross.

Forty feet was formerly considered the maximum height at which centrifugal pumps could operate efficiently, and experiments conducted in 1874, 1875, and 1876 by William O. Webber seemed to demonstrate that the highest efficiency in the single-stage pump was found at a height of about 32 feet, and a maximum velocity of the liquid being pumped through the discharge orifice of the pump of not exceeding 12 feet per second. In Appold's experiments it was determined that the efficiency mainly depended upon the form of the blades in the impeller or vane and the shape of the volute or enveloping case, and that the best form for the blade was a curve, pointing in the opposite direction to that in which the impeller revolved, and for the case, that of a spiral tapering type or volute.



The horizontally-shaded portion of the map shows the vast area of Manchuria, which Russia returns to China. The other shaded portions show the southern half of Saghalien which will belong to Japan, and Korea which passes under Japanese control. The Liaotung Peninsula with Port Arthur and Dalny are transferred to Japan.

MAP SHOWING THE SCENE OF THE RUSSO-JAPANESE WAR AND THE TERRITORY ACQUIRED BY JAPAN.

of infecting oysters with these worms, and thereby increasing the supply of pearls?

The true pearl oyster (*Meleagrina margaritifera*) is found chiefly in the Indian Ocean, the Red Sea, the warmer parts of the South Pacific, the Gulf of California, the Caribbean Sea, and other bodies of water. The local conditions, supply, etc., vary greatly in different regions.

The pearl fisheries of India have long been famous. The most important are in the Gulf of Manar. On the Ceylon side the fisheries were very profitable in 1903 and 1904. The seasons are irregular here, as elsewhere, owing to the frequent disappearance of the oysters before they reach the proper age of production, which is four to six years.

As the *modus operandi* of these fisheries is in general similar in every region, a brief description of that employed in the Ceylon fisheries will suffice for all. When conditions are favorable, a fishery is organized, and two hundred or more large boats are fitted out, manned by sturdy natives, each boat having its complement of divers. The boats, grouped in fleets of sixty or seventy each, start at night so as to reach the banks by sunrise. Each boat generally carries two divers, and is manned by ten rowers, a steersman, and a shark-charmer (*pillal karras*). He is a very important personage, for upon his mystic ceremonies the diver chiefly relies for protection from the numerous sharks; but he also arms himself with a club in case the incantations of the "charmer" should fail! As soon as the